4.0 EXISTING CONDITIONS AND AFFECTED ENVIRONMENT

The following section contains a description of the existing conditions. The description provides a basis for measuring impacts associated with the construction and maintenance of potential straightening of the Tolchester Channel S-Turn. The potential impacts are discussed in Section 5.

4.1 PROJECT AREA DESCRIPTION

The project area is shown on Figure 1-1. The Tolchester Channel S-Turn is located approximately 20 miles east of Baltimore and extends within 1,000 feet of the Maryland Eastern Shore. Depths in the area of the proposed Tolchester S-Turn straightening currently range from approximately -23 to -28 feet MLLW. The two placement options have been described in Section 3.3. The Hart Miller Island Containment Facility is at the mouth of Back River, approximately 14 miles east of Baltimore and approximately 6 miles northwest of the Tolchester S Turn. Poplar Island is located near St. Michaels and is approximately 32 miles south of the Tolchester S-Turn.

For purposes of this EA, the impact area is considered to be the existing S-Turn, the proposed new channel alignment, and an area within approximately 2 miles in all directions. This includes Tolchester Beach. The area of influence for the placement sites includes the actual placement facility and the near-field, open-water areas, approximately 1/2 mile in each direction, unless otherwise specified.

4.1.1 Background – Port of Baltimore

The Port of Baltimore is located on a 32-square-mile area of the Patapsco River and its tributaries, approximately 12 miles northwest of the Chesapeake Bay. The land surrounding Baltimore Harbor is highly developed. More than 43 percent of the defined area is industrial, and 7.5 percent is classified as commercial. Only 34 percent of the area consists of urban and residential land use. Water use predominantly centers on commercial shipping due to the extensive public and private port facilities and the deep-draft channel system. Other water uses include recreational boating and commercial fishing.

By the end of the Revolutionary War, Baltimore had established regularly scheduled sailing services. In the 19th century, ship building, warehouses, and piers continued to expand and multiply to meet the needs of the growing local and regional markets. Vessels arrive at and depart from the Port of Baltimore via the southern Chesapeake Bay (Cape Henry) route or the northern Chesapeake Bay route through the C&D Canal. Vessels using the C&D Canal for passage to or from the Port of Baltimore are currently limited to a draft of 33 feet or less on the northern approach channels through the C&D Canal (which is authorized and maintained to a depth of 35 feet). Vessels with sailing drafts greater than 33 feet must use the main shipping channel (Cape Henry) route into the Port of Baltimore. The southern approach channels, from Cape Henry to the Port, were deepened to 50 feet in October 1990 as part of the Baltimore Harbor and Channels 50-

Foot Project. Vessels using the southern approach channels are limited to drafts of 48 feet or less.

The Port of Baltimore is a major facilitator in the thriving Baltimore-Washington megalopolis. It is a major node in the distribution networks feeding the markets of New York, New York; Newark, New Jersey; Philadelphia, Pennsylvania; and Washington, DC. The Port is the most inland seaport on the East Coast, providing easy connections to America's industrial heartland. Baltimore also contributes to East Coast markets as far north as Boston, Massachusetts, and as far south as Charlotte, North Carolina. The Port of Baltimore is one of America's busiest deep-water ports. The Port's 45-mile shoreline supports many modern public and private cargo terminals, which handle a wide variety of general (containerized), specialized, and bulk cargoes. Vessels calling on the Port of Baltimore include autocarriers, break bulk vessels, container vessels, dry bulk vessels, tankers, RORO (roll-on–roll-off) carriers, general cargo vessels, cableships, naval ships, tugs, and tug/barge combinations. Foreign commerce is a mix of bulk, general, and specialized cargoes.

The Port is situated in a sheltered harbor and is accessible to major American and foreign ports. This combination attracts manufacturing industries profiting from the inexpensive shipment of bulk raw materials. Since the turn of the 20th century, the types of bulk commodities moving through the Port have remained the same. Imports of iron ore from Chile and Canada feed Bethlehem Steel, and coal exports from West Virginia provide fuel for around the world. In addition, large flows of grain have continued to move out of the Port to various global destinations. The Port's proximity to Eastern and Midwestern markets is an added attraction to manufacturers. Table 4-1 summarizes the Port of Baltimore's top 10 trade routes in terms of commodity tonnages by route for the year 1999.

Table 4-1
Top 10 Trade Routes for Baltimore 1999

Country	1000 Short Tons—1999	Percentage of Total
World	22,965	
Canada	4,351	18.95
Brazil	2,865	12.48
Japan	1,577	6.87
Germany	955	4.16
United Kingdom	933	4.06
Netherlands	915	3.98
Ireland	895	3.90
Venezuela	824	3.59
China	682	2.97
Israel	631	2.75
Russia	572	2.49
Suriname	541	2.36
Mexico	519	2.26
Australia	507	2.21
Chile	482	2.10
Portugal	437	1.90
South Africa, Rep of	416	1.81
Norway	348	1.52
France	340	1.48
Italy	305	1.33
Bahamas	280	1.22
Indonesia	273	1.19
Finland	267	1.16
Spain	250	1.09

Commodities and tonnages handled through the Port of Baltimore are projected to increase steadily through the year 2010. From a 1991 total commodity flow of 37.7 million tons, commodity flows through Baltimore increased to 40.1 million tons in 1998 and are forecast to continue to increase through the year 2010. Beyond 2010, commodity flows are projected to grow at an average annual rate of 2 to 3 percent by the year 2050. Major commodities expected to move through Baltimore are grain, coal and coke, lumber and plywood, iron and steel, automobiles, cement and lime, and light industrial equipment.

4.1.2 Existing Navigation Projects

This study incorporates Port of Baltimore vessel movements via the existing water resource projects under the authority of USACE, Baltimore District and Philadelphia District.

4.1.2.1 Baltimore Harbor and Channels

The existing project for the Baltimore Harbor and Channels was adopted by the River and Harbor Act of 8 August 1917 and modified by the River and Harbor Acts of 21 January 1927, 3 July 1930, 7 October 1940, 2 March 1945, 3 July 1958, and 31 December 1970. The existing navigation project is shown in Figures 4-1 and 4-2.

The existing project includes a main channel, 50 feet deep, between Cape Henry, Virginia, and Fort McHenry at Baltimore. The authorized dimensions of the channels are as follows:

1. <u>Cape Henry Channel</u>: 50 feet deep and 1,000 feet wide from the 50-foot depth curve in the Atlantic Ocean to that depth in the Chesapeake Bay, a distance of 3 miles.

2. <u>York Spit Channel</u>: 50 feet deep and 1,000 feet wide connecting the 50-foot depth curves in the Chesapeake Bay opposite the York River near York Spit, a distance of 18.4 miles.

3. <u>Rappahannock Shoal Channel</u>: 50 feet deep and 1,000 feet wide connecting the 50-foot depth curves in the Chesapeake Bay opposite the Rappahannock River, a distance of 10.3 miles.

4. <u>Craighill Approach Channel to Fort McHenry</u>: 50 feet deep and generally 800 feet wide, widened at the entrance and bends, from the 50-foot depth curve in the Chesapeake Bay opposite the mouth of the Magothy River to Fort McHenry on the Patapsco River, a distance of 20.7 miles.

The existing project also authorizes a series of branch channels that provide access to the various public and private terminals serving the Port of Baltimore and that connect the main channel with the C&D Canal. The dimensions of the branch channels are as follows:

1. <u>Connecting Channel to Chesapeake Bay and Delaware Canal Approach Channel</u>: 35 feet deep, 600 feet wide, and 15.6 miles long from the Cutoff Angle in the main channel to the 35-foot depth curves in the natural channel on the east side of the Chesapeake Bay, which is part of the inland waterway from the Delaware River to the Chesapeake Bay. The channel includes the Brewerton Channel Eastern Extension, Swan Point Channel, and Tolchester Channel.

2. <u>Curtis Bay Channel</u>: 50 feet deep, 600 feet wide, and 2.2 miles long from the main channel to and including a 1,275-foot-wide turning basin at the head of Curtis Bay.

3. Curtis Creek:

a. A channel 35 feet deep and 200 feet wide from the 50-foot channel in Curtis Bay to 750 feet downstream of the Pennington Avenue Bridge, a distance of 0.9 mile.

b. A channel 22 feet deep and 200 feet wide from the 35-foot channel to and along the marginal wharf of the Curtis Bay Ordnance Depot.

c. An irregularly shaped basin 18 feet deep and 320 feet wide, adjacent to the head of the 22-foot channel, a distance of 600 feet.

d. A basin 15 feet deep and 450 feet wide, from the end of the 22-foot channel to the end of the marginal wharf, a distance of 0.2 mile.

e. A channel 22 feet deep and 200 feet wide, from the 22-foot channel of the CSX Rail Transport bridge to the vicinity of Arundel Cove, a distance of 2,800 feet, then 100 feet wide in Arundel Cove for a distance of 2,100 feet, with an anchorage basin 700 feet square adjacent to the channel and southwest of the wharf of the Coast Guard Depot at Curtis Bay.

4. Middle Branch: Ferry Bar East Section: A channel 42 feet deep and 600 feet wide, from the main channel at Fort McHenry to Ferry Bar, a distance of 1.4 miles.

NOTE: The West Ferry Bar and Spring Garden Sections of the existing project were deauthorized by Section 1001 of the Water Resources Development Act of 1986, PL 99-662.

5. Northwest Branch:

a. East Channel: A channel 600 feet wide and 49 feet deep from the Fort McHenry channel for 1.3 miles, with a 950-foot-wide turning basin at the head of the channel.

b. West Channel: A channel 600 feet wide and 40 feet deep from the East Channel for 1.3 miles, with a 1,050-foot-wide turning basin at the head of the channel.

Anchorages

There are four anchorages authorized under the existing Baltimore Harbor and Channels project. These anchorages are maintained by the Federal government and are regulated by the U.S. Coast Guard.

1. Anchorage # 1 Fort McHenry Anchorage: In the Patapsco River near the intersection of the Fort McHenry Channel and the Ferry Bar Channel; 35 feet deep, 3,500 feet long, and 400 feet wide.

2. Anchorage #3 (Riverview Anchorage # 1): In the Patapsco River, along the northeast side of the Fort McHenry Channel, southwest of Seagirt Marine Terminal; 35 feet deep, 4,500 feet long, and 1,500 feet wide.

3. Anchorage # 4 (Riverview Anchorage # 2): In the Patapsco River, along the northeast side of the Ft. McHenry Channel 3,000 feet southwest of the Dundalk Marine Terminal; 30 feet deep, 2,400 feet long, 1,200 feet wide.

4. Quarantine Anchorage: In the Patapsco River near Hawkins Point, southeast of the angle between Fort McHenry Channel and Curtis Bay Channel; 35 feet deep, 3,500 feet long, and 600 feet wide. Regulation of the Quarantine Anchorage was canceled by the U.S. Coast Guard effective January 1970 due to the construction of the Francis Scott Key Bridge and the anchorage was deauthorized in 1970.

There are four other anchorages in Baltimore Harbor which are authorized by the U.S. Coast Guard. These anchorages utilize existing depths, are shown on navigation charts, but are not dredged.

4.1.2.2 Chesapeake and Delaware Canal

The existing project for the C&D Canal is maintained under the jurisdiction of USACE, Philadelphia District. The project was adopted as House Document 63-196 in 1919 and modified by Section 3 of the Rivers and Harbors Committee Document 71-41 and Senate Document 71-151 in 1930; by House Document 72-201, House Document 73-18, and House Document 73-24 in 1935; and by Senate Document 83-123 in 1954. The existing navigation project is shown in Figure 4-3.

The Inland Waterway Project (Delaware River to the C&D Canal and Chesapeake Bay) was initiated with the purchase of the canal by the United States in 1919. The existing project provides a channel 35 feet deep and 450 feet wide from the Delaware River through Elk River and the Chesapeake Bay to the 35-foot depth contour in the Chesapeake Bay.

The project also provides for modifications to bridge crossings, including a railroad crossing with 138 feet of vertical clearance at full lift and a horizontal clearance of 600 feet; high level highway bridges with 135 feet of vertical clearance and 500 feet of horizontal clearance at Reedy Point (two lanes), St. George’s (four lanes), Summit (four lanes), and Chesapeake City (two lanes); and a bascule drawbridge across the Delaware City Branch Channel.

Other improvements authorized under the existing project include extension of the entrance jetties at Reedy Point; an anchorage in Elk River, 35 feet deep, 1,200 feet wide, and an average length of 3,700 feet; enlargement of the anchorage and mooring basin in Back Creek to 12 feet deep, 400 feet wide, and 100 feet long; a branch channel 8 feet deep and 50 feet wide at Delaware City and deepening of the existing basin to 8 feet; revetment along banks of the Delaware City Branch Channel east of the Fifth Street Bridge; and construction of bulkheads.

A feasibility study, conducted by Philadelphia District to investigate the feasibility of deepening the channel through the Canal and its approaches, was completed in August 1996. The study recommended deepening the channel to 40 feet, but HQUSACE recommended that additional studies be conducted during Preconstruction Engineering and Design (PED) to determine the appropriate depth. The deepening project was authorized by the WRDA of 1996. The Philadelphia District conducted PED studies over the last several years. However, the Philadelphia District suspended PED studies on January 22, 2001, as a result of some recent downturns in container ship traffic calling on the Port, and reclassified the study from the "active" to the "deferred" budgeting category. The MPA will provide economic updates to the Philadelphia District every six months for the next three years. The Philadelphia District will reevaluate the project after three years to determine whether to reclassify the project to the "active" category and continue the PED studies.

4.1.2.3 Non-Federal Branch Channels

There are several non-Federal branch channels that connect the main shipping channels with various public facilities throughout the Port of Baltimore. The branch channels are generally 36, 38, and 42 feet deep and vary in width from 300 to 500 feet. The branch channels are shown in Figure 4-4 and include West Seagirt Branch Channel, Seagirt/Dundalk Connecting Channel, West Dundalk Branch Channel, East Dundalk Branch Channel, and South Locust Point Branch Channel and turning basin. Maintenance of these branch channels and the berthing areas is currently the responsibility of MPA. There are also numerous private channels and berthing areas up to 50 feet deep which provide access to the many private Port facilities.

4.1.3 Physiography

The Chesapeake Bay was formed approximately 12,000 years ago when the last sheet of glacial ice in the Susquehanna Valley melted, raising sea level and flooding the ancient Susquehanna River Valley. The old riverbed formed the deep channels of the 180-mile-long Chesapeake Bay. The Chesapeake Bay is shallow, with the depth of the mainstem averaging less than 30 feet.

4.1.3.1 <u>Site Geology</u>

<u>Tolchester Channel S-Turn</u>

The Tolchester Beach area, including the Tolchester Channel S-Turn in the Chesapeake Bay, is located in the Atlantic Coastal Plain Physiographic Province. The Atlantic Coastal Plain is characterized by alternating sequences of unconsolidated clays, silts, sands, and gravels of Cretaceous, Tertiary, and Quaternary age. The Coastal Plain forms a wedge-shaped sequence of sediments which thicken to the southeast towards the Atlantic Ocean. These unconsolidated units are underlain by Pre-Cretaceous crystalline rocks which make up the Piedmont Physiographic Province. The contact between the Piedmont and Coastal Plain is referred to as the "Fall Line." The Fall Line intersects Baltimore City to the west of the project site, and trends in a northeast-southwest direction. Bedrock beneath the Tolchester Beach area is approximately 1,300 feet below mean sea level (MSL) (Otton and Mandle 1984).

Bedding of Coastal Plain sediments trends northeast-southwest and dips to the southeast at approximately 50 feet per mile. The regional geology from oldest to youngest (and deepest to shallowest) in the Tolchester Channel area are as follows: Potomac Group [which includes the Patuxent, Arundel, and Patapsco Formations, and is approximately 1,100 feet thick in the project area based on Otton and Mandle (1984)], the Magothy Formation, and paleochannel deposits. Holocene (recent) unconsolidated, soft, sedimentary units of sand, silt, and clay overly the preceding sequence. In the Tolchester Beach area, the Magothy and Quaternary Alluvium (including the Holocene) together account for a thickness of approximately 150 to 200 feet. In the easternmost portion of the Chesapeake Bay, just offshore of the Tolchester Beach area and within the approximate location of the current navigational channel, a deep (180 feet thick) paleochannel called the Exmore Paleochannel exists [based on interpretation of Colman and Halka (1990)]. This paleochannel is an ancient river channel of the Susquehanna formed during a glacial low sea-level stand which contains channel-fill deposits, coarse fluvial sands and fine gravels at the base and becoming finer grained (muddy sand, silt, and peat) upward in the sequence. The paleochannel has created a local erosional unconformity in the immediate Tolchester Channel area. See Figure 4-5 for a generalized geohydrologic cross section.

Sediment encountered in the proposed Tolchester Realignment Channel Subsurface Investigation (USACE 2000) consisted of Holocene deposits of very soft, plastic, and organic clays to a depth of -46 feet MLLW. These sediments are fluvial in origin and were likely deposited on partly eroded Magothy Formation sediments. The recent sediments are generally much softer than the underlying formation sediments with the uppermost layers of the recent deposits typically being a fluid mud. The current depths in the area proposed for dredging range from -23 to -28 feet MLLW.

HMI

The Maryland Geological Survey (MGS) has completed an extensive review of the geological history of HMI. The islands are erosional remnants of a Patapsco River neck extension that was a peninsula extending out into the mouth of Back River. With time, the daily activity of waves and currents eroded the peninsulas at different rates. Maximum erosion occurred at weak points and minimum erosion at strong points. The subsurface geology of the islands indicates a clay lens approximately 60 feet thick with surrounding and underlying sands and gravels. The erodibility of the clay is far less than sands and the resultant effect is differential erosion and island formulation. However, the island placement site is armored with rock which significantly decreases the erodibility.

Poplar Island

Studies of the geology of the Poplar Island area were undertaken for the Environmental Impact Statement for the project in 1995. It was found that Poplar Island is comprised of, and underlain by, Quaternary lowland sedimentary deposits consisting of sand, gravel, silt, and clay. These deposits form the islands and are underlain by the Choptank and Calvert Formations at a depth of 200 feet. Subsurface borings indicated the presence of four strata that were predominantly silty-clays of varying organic content (lower) and silty-sand near the surface. The upper (silty-sand) strata was not present in all sampling locations, which may be a result of differential erosion around the archipelago.

4.1.3.2 Site Hydrogeology

Tolchester Channel S-Turn and HMI

The Magothy Aquifer (Magothy Formation) is the predominant hydrogeologic resource of concern within close proximity of the Tolchester Channel site and HMI. This aquifer consists of loose, white, lignitic "sugary" sand, with interbeds of gray to dark gray laminated silt and clay (Otton and Mandle 1984). Although the Magothy Aquifer, with a thickness of approximately 57 feet at nearby Fairlee, Maryland, is present below Tolchester, it is believed to be eroded away by the Exmore Paleochannel within the eastern Bay. Owing to the 180-foot relief of the paleochannel and its infilling primarily with fine-grained estuarine sediments of relatively low hydraulic conductivity, the Magothy Aquifer (Magothy Formation) is believed to be hydraulically disconnected from the paleochannel and recent deposits within the Tolchester Channel study area. If the proposed Tolchester Channel were to be dredged to a maximum depth of -39 feet MLLW, at least 7 feet of the plastic clay encountered during the subsurface investigation (from -39 to -46 feet MLLW, USACE 2000) would still be present below the channel to act as a groundwater flow barrier.

Local groundwater flow is believed to be from the Eastern Shore of the Bay westward into the Chesapeake Bay, as shown by the generalized groundwater flow lines in Figure 4-5 (Otton and Mandle 1984). Only a limited amount of pumpage reportedly occurs from the Magothy in the eastern upper Chesapeake Bay area, primarily from the municipalities of Rock Hall and Fairlee, Maryland. Residents of Tolchester Beach reportedly rely on individual domestic wells for water supply. The effects of local municipal and domestic pumpage from the Magothy in the Tolchester Beach, Fairlee, and Rock Hall areas are not believed to impact the potentiometric surface at the proposed project site.

Poplar Island

In Maryland, the predominant aquifer systems (from shallowest to deepest) are: the Chesapeake (Eastern Shore only), the Aquia group (including the Aquia and Piney Point–Nanjemoy subaquifers), the Severn-Magothy Aquifer, and Potomac Group (including the Patapsco and Patuxent subaquifers). These aquifers are "separated" by confining layers, usually of clay or fine sand. At Poplar Island, the Aquia Aquifer, or one of its subaquifers, is the hydrogeologic unit closest to the surface; that is, nearest to the bottom of the Bay.

The Aquia Aquifer serves as the primary drinking water source for Kent Island and adjacent areas of Queen Anne's County and Talbot County. A steady decline in the elevation of the Aquia Aquifer by several meters from the mid-1950s to 1984 has occurred, and high chloride concentrations in wells screened in the aquifer near the Chesapeake Bay have been recorded. A number of factors make the Aquia Aquifer susceptible to brackish-water intrusion: the aquifer is shallow in the vicinity of the Chesapeake Bay, incised paleochannels have disrupted the existing impermeable confining layers, and high pumping rates for drinking water have caused recharge of the Aquifer from the Bay. Because of the increasing demand placed on this Aquifer, MGS initiated an investigation to provide a better understanding of the hydrogeologic system (Drummond 1988).

Kent Island and other Eastern Shore areas are experiencing salt-water intrusion problems due to brackish recharge of the Aquia Aquifer from the Chesapeake Bay. This recharge from the Bay is caused by pumping from the Aquia Aquifer in excess of the natural recharge from precipitation particularly for larger consumers like the town of Easton. Brackish water is present in the Aquia Aquifer underneath the Chesapeake Bay shore from the northernmost tip of the island (Love Point) to at least as far south as Prices Creek.

Groundwater modeling studies (Drummond 1988) have shown that the brackish-water/fresh-water interface moves inland at approximately 21 feet per year. This calculation was based upon expected increases in pumping rates due to development. If pumping from the Aquia Aquifer were terminated, the brackish-water/fresh-water interface would actually reverse direction and move towards the Bay at a rate of approximately 2 feet per year.

4.1.4 Climate

The project and placement areas have a continental-type climate with four distinct seasons, although extreme winter and summer temperatures are moderated somewhat by the Chesapeake Bay. The average annual temperature is 62 degrees Fahrenheit (F), with the highest temperatures occurring in late July (average maximum, 89 degrees F) and the lowest temperatures occurring in January and February (average minimum, 21 degrees F). Annual precipitation ranges from 40 to 44 inches, distributed fairly evenly throughout the year. The lowest average monthly precipitation (2.57 inches) occurs in January and the highest (4.26 inches) in August. Winter low pressure systems moving up the Atlantic Coast cause most of the precipitation during the cold months, while summer showers and thunderstorms provide warm weather precipitation. Average snowfall in the project area is 20 to 25 inches, mainly occurring in December, January, and February. The prevailing winds are southerly from May through September and west-northwesterly to northwesterly during the rest of the year. Hurricanes, blizzards, tornadoes, and other destructive storms occur occasionally.

4.1.5 Sediments

4.1.5.1 Origins

The Chesapeake Bay is located in the Atlantic Coastal Plain Physiographic Province and is underlain by sequences of clay, silt, sand, and gravel. These geologically unconsolidated sediments date from the Cretaceous, Tertiary, and Quaternary Periods and were described in the geology section.

4.1.5.2 Sediment Composition

S-Turn Straightening

The bottom sediments in the Chesapeake Bay and the approach channels to the Baltimore Harbor are predominantly clayey silt, with some occurrences of sand-silt-clay. Due to the proposed straightened channel's location in the upper Chesapeake Bay, the primary sources of sediments are runoff from the Susquehanna River, shoreline erosion, and the resuspension of Bay bottom sediments from wave action and ship energy.

Previous sediment characterizations of the Tolchester area by the Greeley-Polhemus Group, Inc. (1994) as part of the C&D Canal Deepening studies indicated that sediments in the area proposed for straightening are dominated by silts and clays. In 1995 and 1999, sediment samples were collected by the USACE from the proposed alignment to straighten the Tolchester Channel S-Turn. These samples were analyzed to determine dredged material placement requirements by identifying the chemical content of the sediments (environmental borings). Samples were also collected in 1999 to characterize the dredging conditions by analyzing the geophysical properties of the sediments (geotechnical borings). The results of the 1995 and 1999 studies and 1999 geotechnical investigations are included in Appendix V. The locations of the geotechnical borings are shown on Figure 4-6. Geotechnical investigations indicated that the material consists of generally soft, highly plastic **(**fatty and organic) clay with occasional fractions of shell or shell fragments, sand, gravel, cobbles, and wood pieces, and mixtures thereof. Typically, these sediments are too fine-grained to be used to create structure unless they are contained.

HMI

The current sediment composition within HMI is a homogenized mix of sediments dredged from the Bay and Baltimore Harbor over the past 16 years. The subsurface geology of the islands' surrounding area indicates a clay lens approximately 60 feet thick with surrounding and underlying sands and gravels. The island is armored with rock, which has significantly decreased the erodibility.

Poplar Island

Subsurface borings taken in the vicinity of the island indicated the presence of four strata that were predominantly silty-clays of varying organic content (lower strata) and silty-sand near the surface. The upper (silty-sand) stratum was not present in all sampling locations, which may be a result of differential erosion around the archipelago. Due to construction, much of the local (overlying) sand within the footprint of the site has been moved to create the sand dikes. Once filled, the sediment composition within the site will be similar, predominantly silts and clays, to that of the project channels.

4.1.5.3 Sediment Quality

Sediments serve as a sink and a source for natural materials, as well as organic contaminants which bind to fine particulates that may be deposited and buried within sediments. Disturbance by dredging can re-mobilize contaminants and particulates from the sediment into the water column. Areas proposed for dredging in urbanized watersheds can contain measurable quantities of contaminants. Contaminants originate from both point-sources (e.g., industrial and municipal effluents) and non-point sources (e.g., stormwater runoff, agricultural runoff, shoreline erosion and atmospheric deposition).

S-Turn Straightening

The sediments in the vicinity of the Tolchester straightening are not directly influenced by urban or industrial point sources, but they are mostly influenced by non-point sources within the Chesapeake Bay watershed. The channel sediments are comprised of silts and clays (depositional materials) that originate from within the watershed. The Susquehanna River contributes a large portion of silts and clays to the upper Chesapeake Bay region, and total organic carbon (TOC) concentrations in sediments peak in the upper Bay region (Eskin et al. 1996).

In 1999, sediment samples were collected from two locations within the proposed dredging area for the straightening of the Tolchester S-Turn to evaluate the potential for open water placement (Figure 4-7; EA 2000a). Ten-foot subsurface core samples from two locations were collected and separately tested (September–October 1999), and one composite sample from the two locations was collected and tested (December 1999–January 2000). The tested sediments were representative of the native material that would be dredged to straighten the channel. Sediment samples were subjected to: (1) physical and chemical tests to define the existing physical characteristics and chemical constituents in the sediment proposed for dredging; (2) elutriate tests to identify dissolved chemical constituents that could potentially be released from the sediment into the water column during open water placement; (3) bioassays to assess the potential for acute water-column and whole sediment toxicity to aquatic organisms during open water placement; and (4) laboratory bioaccumulation studies to assess the potential for uptake of contaminants from the sediment into the tissue of benthic organisms after open water placement.

Methods

Testing of the sediments followed guidance in the *Inland Testing Manual* (USEPA/USACE 1998) (ITM) and *QA/QC Guidance for Dredged Material Evaluations* (USEPA/USACE 1995a). The ITM describes testing and evaluation procedures for dredged material proposed for open water placement in either fresh, estuarine, or saline (near coastal) waters of the United States, in accordance with 40 CFR 230.60 and 230.61. The project-specific sampling and testing methods are provided in EA (2000a).

The ITM analyses were performed to evaluate the sediments proposed for open water placement; however, open water placement is not under consideration for this project. The results of the testing are presented here to further describe the sediment quality.

Physical Characteristics of the Sediment

Physical analysis of the sediment is usually performed for any type of dredging and dredged material placement project. Physical characteristics include grain size and moisture content determinations. Since organic contaminants preferentially attach to fine grained and organic particles, sediments with a high percentage of sand are likely to contain fewer and lower concentrations of contaminants than sediments with higher percentages of silt and clay particles. Therefore, sediments primarily comprised of sand or which are far removed from contaminant sources may qualify for testing exclusions. Sediments composed largely of silts and clays have a higher likelihood of containing organic contaminants.

Physical characteristics and TOC concentrations for the Tolchester straightening sediment samples are summarized in Table 4-2.

Table 4-2
Results of Physical Analyses and TOC Determinations

Cruise Date	Station	Core Depth (feet)	No. of Cores Composited for Testing	Moisture (%)	TOC (%)	Sand (%)	Silt/Clay (%)
SEP 1999	TLS-001VC	10	2	53.1	> 14.1	0.6	99.4
	TLS-002VC	10	2	58.6	13.1	0.3	99.7
DEC 1999	TLSVCCOMP	10*	4*	53.3	12.9	2.4	97.6

*TLSVCCOMP consisted of a composite of two 10-foot cores from TLS-001VC and two 10-foot cores from TLS-002VC

Grain size determinations indicated that the sediments were primarily comprised of fine silts and clays, and TOC determinations indicated that the sediments contained a high percentage of organic material (13.4 percent average). TOC concentrations in the Tolchester straightening sediment cores were higher than those found in surficial sediments of upper Bay channels proposed for maintenance dredging (EA 2000a). Additional geotechnical and physical analyses are included in Appendix V.

Chemical Concentrations in the Sediment and Elutriates

The major types of contaminants that potentially occur in sediments include bulk organics (hydrocarbons that include oil and grease), halogenated hydrocarbons (persistent organics that degrade slowly), polycyclic aromatic hydrocarbons (PAHs, organics that include petroleum products and petroleum by-products), metals, and nutrients.

The 10-foot sediment core samples that were collected in September 1999 (TLS-001VC and TLS-002VC) were tested for the following suite of chemical constituents: volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), chlorinated and organophosphorus pesticides, polychlorinated biphenyl (PCB) congeners, PAHs, metals, butyltins, ammonia, nitrate and nitrite, cyanide, total sulfide, total Kjeldahl nitrogen (TKN), total phosphorus, simultaneously extracted metals (SEM)/acid volatile sulfides (AVS), biological oxygen demand (BOD), and chemical oxygen demand (COD). The sediment composite collected in December 1999 (TLSVCCOMP) was tested for dioxin/furan congeners, TOC, and physical analyses only. A list of the tested constituents and a summary of the detected chemical constituents in the Tolchester straightening sediment is provided in Appendix V.

Concentrations of detected chemical constituents in the sediment samples were compared against Sediment Quality Guidelines (SQGs) for marine sediments. SQGs are used as *screening* tools to assess the *potential* for sediment to cause adverse effects to aquatic benthic organisms. Two of the most commonly used screening levels that attempt to provide sediment contaminant concentration values that differentiate sediments of little concern from those predicted to have adverse biological effects are Threshold Effects Levels (TELs) and Probable Effects Levels (PELS) (Buchman 1999; MacDonald 1994; MacDonald et al. 1996). TELs represent the contaminant concentration below which adverse biological effects are expected to rarely occur. PELs represent the contaminant concentration above which adverse biological effects are expected to most frequently occur. Values that fall between the TEL and PEL values represent the concentrations at which adverse biological effects are expected to occasionally occur (MacDonald 1994; McDonald et al. 1996).

Exceedances of TEL and PEL values do not definitively indicate that a sediment sample is toxic. Recent evaluations of large chemical and toxicity data sets [O'Connor et al. 1998; O'Connor and Paul (1999)] have indicated that TEL/PEL screening is not a reliable method for predicting sample toxicity or for screening samples out as non-toxic. For dredged material evaluations, SQGs are used as a tool to identify *potential* contaminants of concern and to provide additional weight of evidence in the evaluation [USACE Waterways Experiment Station (WES) 1998]. Comparisons of sediment chemical concentrations to TEL/PEL values are provided in Appendix V.

In addition to testing bulk sediments, elutriates were created by mixing dredging site water and sediment, allowing the mixture to settle, and filtering and testing the overlying water for dissolved constituents per USEPA/USACE (1998) guidance. The purpose of elutriate testing is to simulate the potential mixing and release of organic or inorganic constituents into the water column during hydraulic placement of dredged material in open-water sites. The results of elutriate analyses are most appropriately used for evaluating impacts associated with hydraulic placement in open water, not upland placement, and they do not qualitatively or quantitatively represent a release of constituents into the water column during the dredging process or from return water from a confined placement site. Releases that would be expected at the dredging site during mechanical dredging or in return water from a confined placement site are substantially less than those that would occur during open water placement.

Sediments collected from the proposed Tolchester straightening area were composited and used to create two elutriate samples for analysis (EA 2000a). Analytes detected in the elutriates were compared to Maryland Department of the Environment (MDE) proposed water quality criteria [Maryland Register 27(17): 1628-1636] and USEPA saltwater acute and chronic aquatic life water quality criteria and water quality criteria for the protection of human health from the consumption of aquatic organisms [USEPA 1998 *National Recommended Water Quality Criteria* [63 Federal Register 68354 – 68364]. Although the elutriate information is presented in this Environmental Assessment, these data should not be relied upon for predicting constituents that would be discharged from an upland or contained facility or for predicting release at the point of dredging. The results of the elutriate testing and applicable EPA water quality criteria are provided in Appendix V.

Results of Chemical Analyses

Overall, few VOCs and SVOCs were detected in the Tolchester straightening sediments and elutriates. In addition, organophosphorus pesticides were not detected in either the sediment or elutriate samples. The results of the metals, PAHs, PCB congeners, chlorinated pesticides, and dioxin/furan analyses are discussed in the following sub-sections.

Metals

The majority of metals detected in sediments are naturally occurring within the environment (e.g., arsenic, cadmium, copper, lead, manganese, nickel, and zinc), and small quantities of some of these metals are essential nutrients for aquatic organisms (USEPA 1996). Metals tend to be naturally elevated in the upper Bay region, and Eskin et al. (1996) noted that, Bay-wide, the highest concentrations and greatest variability of trace metals occur in the upper Bay region from Pooles Island to the Bay Bridge.

Fifteen of the 16 tested metals were detected in the Tolchester straightening sediments. Of the 15 detected metals, mean concentrations of arsenic, copper, lead, mercury, nickel, and zinc exceeded the TEL values. Of these six metals, only nickel concentrations were greater than the PEL.

Arsenic may be naturally released to the environment through volcanic eruptions or by the weathering of arsenic-containing rocks. Anthropogenic (man-made) sources of arsenic include fossil fuel burning and manufacturing of pesticides, wood preservatives, and fertilizers. Elevated arsenic concentrations have been detected throughout the upper Bay region (Eskin et al. 1996). The concentrations of arsenic detected in the Tolchester straightening sediments are within the range of values reported in previous upper Bay studies for sediments with similar grain size characteristics (Eskin et al. 1996).

Copper may be naturally released through weathering of copper-bearing rocks or release of copper sulfide. Man-made sources of copper include wood preservatives, anti-fouling paint, and fungicides (MacDonald 1993). Mercury is released to aquatic environments from naturally occurring mercury in rocks and from anthropogenic sources such as paper mills and chemical facilities (USEPA 1999a). Incineration and fossil fuel combustion release mercury into the atmosphere and it is redeposited on land and surface waters, then absorbed by soils and sediments. Lead primarily originates from industrial uses, including paints, batteries, leaded fuels, and metal manufacturing. Nickel and zinc are natural trace metals that are found in soils and sediments, but can also originate from industrial manufacturing of metals and metal alloys. Previous studies have indicated that nickel and zinc occur at naturally elevated levels in sediments of the upper Chesapeake Bay (Eskin et. al. 1996). The primary man-made source of nickel is combustion of fossil fuels, and refining and electroplating processes. Zinc is detected at high concentrations in urban stormwater, and stormwater runoff is considered to be a major source of zinc to the upper Bay (Eskin et. al. 1996)

Metals accumulate in organism tissues, but most, with the exception of mercury, do not biomagnify in the food chain (Suedel et al. 1994). The bioavailability of divalent metals to aquatic organisms is influenced by the ratio of SEM/AVS. In low oxygenated environments, metals may precipitate with sulfides, making them unavailable for uptake by aquatic organisms. The SEM/AVS ratio in the Tolchester straightening sediment was greater than 1, indicating that some metals (particularly cadmium, copper, lead, nickel, and zinc) may be bound to particulates and, therefore, much less bioavailable to aquatic organisms.

Low concentrations of 12 dissolved metals were detected in the elutriates for the Tolchester straightening. When full strength elutriate (undiluted) was compared to USEPA's ambient water quality criteria, only three metals (arsenic, beryllium, and manganese) were detected at concentrations that exceeded the human health criterion for consumption of aquatic organisms (which is based on daily lifetime consumption of 6.5 grams of fish/day for 70 years). Aquatic life criteria (acute or chronic) were not exceeded. The largest dilution factor required to achieve compliance with the human health criterion would be 19:1 (for manganese).

Polycyclic Aromatic Hydrocarbons

PAHs are found throughout the environment (U.S. Department of Health and Human Services, 1995; Menzie et al. 1992) and are widespread throughout Chesapeake Bay sediments (Eskin et al. 1996; USEPA 1995). PAHs originate from both natural and anthropogenic sources. Forest fires and volcanic eruptions are the primary natural sources of PAHs, and fuel combustion processes are the primary anthropogenic source. PAHs are distributed to aquatic environments via atmospheric deposition. PAHs are divided into two categories: high molecular weight (HMW) and low molecular weight (LMW) PAHs. The HMW PAHs originate from the combustion of fossil fuels and include fluoranthene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, indeno(1,2,3,-cd)pyrene, and pyrene. The LMW PAHs originate from petroleum products and include acenaphthene, naphthalene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, and 2-methyl-naphthalene.

Sixteen tested PAHs were detected in the Tolchester straightening sediments. Mean concentrations of 11 of the 16 detected PAHs exceeded TEL values, and 4 of the 16 detected PAHs exceeded PEL values (acenaphthene, acenaphthylene, fluorene, and naphthalene). The total PAH value [3,295 micrograms per kilogram (μg/kg) parts per billion] (a summation of all PAH concentrations) exceeded the TEL value, but was well below the PEL value. This concentration falls below the mean total PAH concentration of 4,766 ppb that Eskin et al. (1996), found in this region (segment 3) of the Bay. The elevated concentrations of PAHs in this region of the Bay may be related to the high TOC values, as PAHs have a high affinity for particulates. There are no significant point sources for PAHs in the near vicinity of the Tolchester straightening. Eskin et al. (1996) found that PAH concentrations in Bay sediments peak in the upper Bay from Turkey Point to the Patapsco River.

Although detected in the sediments, none of the tested PAHs was detected in elutriate samples.

Polychlorinated Biphenyls

PCBs are man-made chemicals that were historically used in electrical transformers, are wide-spread in the mainstem upper Bay, are persistent in the environment (USEPA 1999b), and are known to bioaccumulate in aquatic organisms. Twenty-three of the 26 tested PCB congeners were detected in the Tolchester straightening sediments; however, mean concentrations of 21 of the 23 detected congeners were detected below the recommended USEPA/USACE (1995) target detection limit (TDL) of 0.01 μg/kg. The mean total PCB concentration in the Tolchester straightening sediments was 11.54 μg/kg, which is approximately one-half the TEL value of 21.55 μg/kg. Such low concentrations of PCBs would, therefore, not be expected to cause adverse effects to aquatic organisms. The concentration reported for the Tolchester straightening sediments falls below the mean total PCB value of 12.4 μg/kg reported by Eskin et al. (1996) in this region (segment 3) of the Bay.

Only 4 of the 26 tested PCB congeners were detected in the elutriate samples for the Tolchester Straightening. All of the detected congeners were measured at or below the recommended USEPA/USACE (1995) TDL of 0.01 microgram per liter (μg/L) (parts per billion). Although the congeners were detected at concentrations that were below the recommended target detection limits, when compared to USEPA's ambient water quality criteria for total PCBs, the human health criterion (which is based on daily lifetime consumption of 6.5 grams/day of fish living in tested waters for 70 years) was exceeded by a factor of 10, if non-detects are equal to zero, and by a factor of 38 if non-detects are conservatively considered to equal ½ of the detection limit. Aquatic life criteria were not exceeded.

Pesticides

Pesticides, such as DDT and DDE, are persistent within the environment and have the potential to bioaccumulate in aquatic organisms and biomagnify in the food chain (Suedel et al. 1994). Of the 22 chlorinated pesticides that were tested, only three were detected in sediments from the Tolchester straightening (4,4'-DDD, 4,4'-DDE, and heptachlor epoxide). None of the concentrations exceeded TEL or PEL values, and the mean concentrations were a minimum of seven times lower than the USEPA/USACE (1995) TDL of 10 μg/kg. Concentrations of pesticides in the eastern upper Bay areas may originate from agricultural applications of pesticides or atmospheric deposition.

Heptachlor and heptachlor epoxide were detected in the Tolchester straightening elutriates, but at concentrations that were below the USEPA/USACE (1995) recommended TDL of 0.1 μg/L. In addition, although not detected in the sediments, beta-BHC and gamma-BHC (lindane) were detected in the Tolchester straightening elutriates. The method detection limits for these two pesticides were 40 to 50 times lower in the elutriates than in the sediments. Gamma-BHC concentrations were detected below the USEPA/USACE (1995) recommended TDL of 0.1 μg/L, and there is no recommended TDL for beta-BHC. When compared to USEPA's ambient water quality criteria for heptachlor and heptachlor epoxide, *chronic* aquatic life criteria (which are defined as 4-day average exposure concentrations) were exceeded by factors of 6 (heptachlor) and 7 (heptachlor epoxide), and the human health criteria (which are based on daily lifetime consumption of 6.5 grams of fish/day for 70 years) were exceeded by factors of 12 (heptachlor) and 18 (heptachlor epoxide).

Dioxin and Furan Congeners

Dioxin and furan congeners are found throughout the environment (USEPA 1999c) and small quantities may be detected in any type of environmental sample (WES 1992). 2,3,7,8-TCDD is the most toxic dioxin congener and is the most frequently studied congener in published literature. Dioxins may be produced by both natural and man-made processes. Forest fires are a natural source of dioxin to the environment. The majority of polychlorinated dioxin and furan congeners, however, are the product of incomplete combustion in the presence of chlorine or the product of industrial chlorination processes (Miller, Norris, and Hawkes 1973). The most common anthropogenic sources of dioxins include incinerators and pulp and paper mills (USEPA 1999c).

Dioxins bind tightly to particulates and are not water-soluble (USEPA 1993); therefore, dioxin impacts are more likely to be associated with sediments than with the water column. Toxicity Equivalency Quotients (TEQs) represent a weighted summation of all dioxin and furan congeners based on the toxicity of each congener in relation to 2,3,7,8-TCDD (the most toxic dioxin congener).

Overall, 17 dioxin/furan congeners were analyzed in the Tolchester straightening sediments. Fifteen congeners were detected, and 11 of the 15 detected concentrations were detected below the USEPA/USACE (1995) recommended TDLs. The concentration of dioxin in the Tolchester straightening sediments (expressed as a TEQ) was 3.8 ng/kg (parts per trillion). Importantly, 2,3,7,8-TCDD (the most toxic congener) was not detected in the Tolchester straightening sediment.

Sediment quality studies by Eskin et al. (1996) detected OCDD (octochlorodibenzo-p-dioxin), the least toxic dioxin congener, in 13 of 16 mainstem Chesapeake Bay stations with concentrations ranging from 10 to 2,670 ng/kg. The concentration of OCDD reported in sediment from the Tolchester straightening was 112 ng/kg. There are no known point sources of dioxin to the upper Bay. Atmospheric deposition is the most likely source of this contaminant to the upper Bay region.

Dioxin and furan congeners are hydrophobic (not easily dissolved in water) and bind tightly to organic particulates. Neither dioxin nor furan congeners were detected in the Tolchester straightening elutriate.

Water Column and Whole Sediment Toxicity Tests

Water column and whole sediment toxicity tests were conducted to assess the potential impacts to water column organisms during open water dredged material placement and to assess the impacts to bottom-dwelling organisms following placement, respectively (EA 2000 a). One composite sediment sample was tested.

The water column toxicity tests were conducted with the following species: *Mysidopsis bahia* (opposum shrimp), *Cyprinodon varieagatis* (sheepshead minnow), *Menidia beryllina* (inland silverside), and *Mylius* sp. (blue mussel). Survival was the endpoint for the opposum shrimp, sheepshead minnow, and inland silverside tests. Normal development was the endpoint of the blue mussel test (shell and hinge development). Results of 96-hour survival tests indicated that the full strength elutriate samples were not acutely toxic to opposum shrimp, sheepshead minnows, or inland silversides. Survival in the Tolchester straightening elutriate sample was not significantly different than survival in the control (laboratory seawater) sample (Table 4-3). Results of the 48-hour blue mussel developmental tests indicated that the 100 percent elutriate adversely affected shell and hinge development in newly hatched mussel larvae (Table 4-3). Larval shell and hinge development in the 50 percent elutriate (1:1 dilution) was not significantly different than development in organisms exposed to laboratory control seawater. It is not known what chemical constituent or combination of chemical constituents in the elutriate impacted the mussel larvae development.

Table 4-3
Summary of Results of Acute Water Column Bioassay for Tolchester Straightening Elutriates

	Opossum Shrimp (% survival*)	Sheepshead Minnow (% survival*)	Inland Silverside (% survival*)	Blue Mussel (% normal development*)
Control	96	100	91	95
Tolchester Straightening				
100% elutriate	94	100	80	0
50% elutriate	98	98	92	84
10% elutriate	92	100	90	95
LC50(a) or EC50(b)	>100 (a)	>100 (a)	>100 (a)	61.7 (b)

* % survival and normal development based on mean of five replicate tests.

The 10-day whole sediment bioassays were conducted with the following species: *Neanthes arenaceodentata* (estuarine polychaete worm) and *Leptocheirus plumulosus* (estuarine amphipod). Survival was the endpoint for the sediment tests. Results of 10-day tests indicated that the Tolchester straightening sediments were not acutely toxic to estuarine polychaete worms or amphipods (Table 4-4). Therefore, following placement, the sediments would be expected to be suitable for successful colonization by benthic invertebrate communities.

Table 4-4
Summary of Results of 10-Day Whole Sediment Bioassays for Tolchester Straightening Sediments

	Estuarine polychaete worm (% survival*)	Estuarine amphipod (% survival*)
Control sediment	100	96
Tolchester Straightening	96	89

* % survival based on mean of five replicate tests.

<u>Laboratory Bioaccumulation Studies</u>

Laboratory bioaccumulation studies were conducted using *Nereis virens* (sand worm) and *Macoma nasuta* (blunt-nose clam). Following a 28-day exposure period to sediment from the proposed Tolchester Channel straightening area, the worm and clam tissues were analyzed for the following constituents: metals, chlorinated pesticides, PAHs, PCB aroclors and congeners, SVOCs, dioxin and furan congeners, lipids, and percent moisture. Results of the chemical analyses are summarized in Table 4-5 and mean chemical concentrations are provided in Appendix V. Results indicated that some metals, chlorinated pesticides, PAHs, PCB congeners, SVOCs, and dioxin and furan congeners were detected in tissues of benthic animals that were exposed to the Tolchester straightening sediments (Table 4-5 and Appendix V). Because the laboratory bioaccumulation studies were conducted to evaluate potential impacts associated with open water placement, the tissue residues for the Tolchester straightening were statistically compared to tissue-residues of benthic animals exposed to sediments from potential open water placement sites. Based on the statistical comparisons to tissue-residues for open water placement sites and based on statistical comparisons to calculated fish tissue screening values (SVs), four chemical constituents in the benthic tissues for Tolchester straightening (dioxin, arsenic, benzo(a)pyrene, and chlorbenside) were classified as contaminants of potential concern (COPCs) for open-water placement (EA 2000a). These four chemicals are being further evaluated in risk assessment studies that are currently underway. The sediments, however, are no longer proposed for open water placement.

Table 4-5
Summary of Results of Tissue Analyses Following 28-day Laboratory Bioaccumulation Studies –
Worms and Clams Exposed to Tolchester Straightening Sediments

Chemical Group	**Number of Chemical Constituents Tested**	**Number of Chemical Constituents Detected***	
		***Nereis virens* (sand worm)**	***Macoma nasuta* (blunt-nose clam)**
Metals	16	10	13
Chlorinated Pesticides	22	7	6
PAHs	16	1	12
PCB Aroclors	7	0	0
PCB Congeners	26	10	3
SVOCs	47	5	8
Dioxin / Furan Congeners	17	13	9

* detected in at least one of five replicate tests for each species

Summary of Physical, Chemical, and Biological Characteristics of Sediments Proposed for Dredging

Arsenic, copper, lead, mercury, zinc, and 7 of 16 PAHs measured were found in bulk sediments at concentrations between the Threshold Effects Level (TEL) and the Probable Effects Level (PEL). Nickel and 4 of 16 PAHs measured in bulk sediments exceeded the PEL. Parameters which were measured above detection limits in the elutriates included: arsenic, beryllium, manganese, four of twenty-six PCB congeners, heptachlor, heptachlor expoxide, Beta-BHC, and Gamma-BHC (lindane). Heptachlor and heptachlor epoxide in the elutriates exceeded aquatic life criteria. Arsenic, beryllium PCBs, heptachlor and heptachlor epoxide in the elutriates exceeded human health criteria.

Sediment bioassays indicated that the sediments are not acutely toxic to estuarine polychaetes or amphipods. Similarly, water column bioassays indicate that full-strength elutriate samples are not acutely toxic to opposum shrimp, sheepshead minnows, or inland silversides. The only effect noted was abnormal shell/hinge development in blue mussel larvae when exposed to full-strength (100 percent) elutriate. With a 50 percent elutriate, the hinge/shell development response was not significantly different than laboratory controls. Bivalves at or near the dredging site would not be exposed to concentrations of 100 percent elutriate because release of sediments within the water column would be minimal. In addition, dredging will not occur during spawning periods.

Laboratory bioaccumulation studies, designed to assess the effects of open-water placement, indicated that some chemical constituents in the sediments accumulated in the tissue of benthic organisms. Many of the detected chemical concentrations in the tissues are not ecologically significant and would not be expected to adversely impact benthic communities or other organisms in the food web (EA 2000 a). A total of eight chemical constituents in the Tolchester straightening sediments are being further evaluated in risk assessment studies of upper Bay channels to ensure that the chemicals would not affect human health or the ecological communities if placed in open water (EA 2001), even though these sediments are no proposed for open water placement. Because the Tolchester straightening sediments would be placed at either HMI or the upland cells at Poplar Island, benthic organisms such as those used in the laboratory bioaccumulation studies, would not be directly exposed to the sediment.

HMI

Sediments contained within HMI originated from the Baltimore Harbor approach channels in the mainstem of the Chesapeake Bay, from within Baltimore Harbor, and from Baltimore County dredging projects. Some of the Inner Harbor sediments contained elevated levels of trace metals, PCBs, and PAHs (EA 2000b; Ashley and Baker 1999) that originate from urban development, historic industrial inputs, and stormwater outfalls within the Harbor, while the mainstem Chesapeake Bay approach channel sediments have substantially lower concentrations of anthropogenic constituents.

Sediments surrounding the containment facility are influenced by spillway discharges and discharges from the Back River Wastewater Treatment Plant. The HMI Exterior Monitoring Program, managed by MDE, monitors trace metal concentrations and grain size characteristics in sediments adjacent to the facility. The physical characteristics of the sediments surrounding the facility include sandy lobes (greater than 90 percent sand) that extend to the north-northeast of the dike and east of Black Marsh. The proportion of silt-clay particles in the sediment increases with distance from the dike (MDE 1998). Elevated levels of zinc (Zn), (zinc enrichment) have been observed southeast of spillway #1 (located on the northeast portion of the dike) during certain previous monitoring years (MDE 1998). More recent monitoring during 1997 concluded that while Zn concentrations may have been elevated and were a concern in the past, the 1997 data do not suggest that this is still the case (MDE 1999a). MDE has also concluded that no persistent chemical or physical changes have been noted in the sediments surrounding the facility (MDE 1999b). Benthic community analysis and tissue monitoring studies have indicated that the elevated zinc concentrations in the sediment have not impacted the benthic communities surrounding the facility (MDE 1998).

Poplar Island

The majority of sediments around Poplar Island are classified as sand, with some clayey silt and silty sands (Hill et al. 1997). Chemical analysis of sediments in the vicinity of Poplar Island was conducted in 1995, prior to the initiation of perimeter dike construction (EA 1996). Results of the 1995 sediment chemistry studies are provided in Appendix V.

Neither VOCs, pesticides, nor PCB aroclors were detected in sediments surrounding the archipelago. Naturally occurring trace metals and one PAH compound (phenanthrene) were detected at concentrations that were substantially below sediment quality guidelines. Metals concentrations were typical for this region of the Bay and comparable to concentrations found in other mid-Bay studies (Eskin et al. 1996). Benthic community characterizations indicated that the Benthic Index of Biotic Integrity (B-IBI) was below 3 within the area, reflecting seasonal stresses from high erosion and storm events [Dalal et al. 1996 (Revised 1999)]. Sediments in the Poplar Island area support naturally occurring benthic communities comparable to other areas of the upper Bay with similar grain size and hydrodynamic characteristics.

4.1.5.4 Shoaling Rates

Tolchester Channel S-Turn

Shoaling in the Tolchester Channel averaged approximately 186,000 cy per year from 1981 to 1997 based upon the quantity of material dredged by contractors during this time. Maintenance dredging is performed approximately every 2 years with the majority of the material being removed from within the existing S-Turn. Based upon the hydrodynamic studies conducted by USACE WES, straightening the channel would decrease the estimated annual shoaling by 23 percent, or approximately 43,000 cy per year. WES modeling of the straightened channel indicated that velocity increases would primarily occur in the new channel. The output from these modeling efforts is included in Appendix VII. Slight velocity decreases [less than 0.21 feet per second (fps)] are predicted within the old channel. The velocity decreases along the northern edge of Hodges Bar were always less than 0.1fps. There were no significant changes in velocities over the majority of Hodges Bar or other nearby oyster bars.These decreases in velocity are not predicted to increase sedimentation rates in the adjacent shallows or on adjacent oyster bars, particularly Hodges Oyster Bar (immediately south of the existing S-Turn).

HMI and Poplar Island

Hydrodynamic modeling of the sedimentation in the vicinity of these two islands was conducted prior to construction to assess the impacts of constructing the sites. Since the sites have been constructed, the placement activities are not expected to change hydrodynamics.

4.2 AIR QUALITY

Tolchester Channel S-Turn, HMI

Sections 109 and 301(a) of the Clean Air Act as amended in 1990 [42 U.S.C. 7409(a)], and USEPA implementing regulations (40 CFR Part 50) define national primary, and secondary ambient air quality standards as judged necessary to protect public health and welfare for "criteria" pollutants. USEPA regulations establish National Ambient Air Quality Standards (NAAQS) for these criteria pollutants, and the agency publishes a list of all geographic areas in relation to their compliance with the NAAQS. Areas where NAAQS are being achieved are designated as "attainment" areas, and areas not in compliance are designated as "nonattainment" areas. The proposed channel straightening project is located in Kent County, Maryland, which is classified as a marginal nonattainment area for ozone, and the HMI facility is located in Baltimore County, which is classified as a severe nonattainment area for ozone. These counties are generally in attainment for other criteria pollutants.

Poplar Island

Poplar Island is located in Talbot County, which is classified as an area that is in attainment for all of the NAAQS for the criteria pollutants, which include nitrogen dioxide, carbon monoxide, sulfur dioxide, particulate matter, and ozone.

4.3 WATER QUALITY

Tolchester Channel S-Turn

Water quality conditions in the Chesapeake Bay area vary due to many factors (proximity to urban areas, type and extent of industrial activity, stream flow characteristics, amount and type of upstream land, and water usage). The water quality in the area of the S-Turn is considered typical of the upper Chesapeake Bay. The depths at the site are sufficiently deep (-23 to -28 feet) that hypoxia and/or anoxia probably occurs in warmer months when temperatures rise above approximately 10-15 °C (CBP long-term database, 1984-1998). In the Bay, areas deeper than about 20 feet can experience low oxygen (hypoxia) from approximately late April through late September) in warmer months and would be less supportive of aquatic life than shallower areas. The project area lies within the turbidity maximum of the upper Bay, and suspended sediment levels may reach 150 mg/L.

A water quality study of deep draft navigation channels in the Chesapeake Bay was undertaken by Cornwell and Boynton (1999). Findings of this study were that in the summer, water in the channels was generally colder, saltier, and had lower dissolved oxygen content than that of the shallow water stations. Sediment flux studies showed that sediment oxygen consumption in the channels was low, ammonium flux was high, and dissolved inorganic phosphorus flux levels were high in the channel sediments when compared to the shallow stations. Sediment geochemistry measured higher pore water ammonium concentrations in channel sediments than in shoal sediments.

This was followed up by studies by Cornwell (1999), Cornwell and Owens (1999), and Cornwell et al. (2000), on potential releases of nitrogen and phosphorus from dredged sediments. Findings were that high pore water ammonium concentrations are present in the channel sediments year-round, as are high pore water soluble reactive phosphorus and iron concentrations in periods of anoxia (late spring-early fall, dependent upon water temperature).

<u>HMI</u>

Each of the five outfall locations at HMI is permitted as a point source discharge, with monitoring requirements and discharge limitations for pH, TSS, and five metals. In the 16 years of facility operation, there have been a total of 11 violations of discharge permit limits. A list of these violations may be found in Table 3-1. Most of the discharges were for exceedance of permitted limits for pH and TSS. No violations have occurred since 1993.

In 1993 a daily maximum non-compliance for total cadmium occurred during the reporting period at outfall 002. The permitted daily maximum is 0.2 mg/L and the concentration in the discharge was 0.231 mg/L. MES conducted extensive monitoring of levels of metals in the ponded water and soils to attempt to determine the cause of the non-compliance. MES concluded that the rise in metals concentrations at spillways 001, 001A, and 002 was a result of the oxidization of the sulfidic dredged material that was increased by the hot, dry weather and extended crust management activities during an 18-month hiatus from dredged material inflow. Coordination by MES with MDE indicated that this one-time release of cadmium was not considered to be a cause for concern. No violations have occurred since then.

Additional monitoring requirements are applied to the primary discharge. The purpose of this sampling is to provide an in-depth analysis of the discharges from the site. This includes semi-annual analysis of more than 120 other potential contaminants. This monitoring is also repeated in adjacent Bay waters. Aquatic toxicity testing of the effluent is performed every 6 months.

<u>Poplar Island</u>

Measurements of *in situ* water quality and nutrient concentrations were made seasonally for existing conditions surveys of the Poplar Island archipelago prior to site construction. Ambient conditions in the area were found to be similar to and typical of conditions in shallow mesohaline [salinity of approximately 5 to 18 parts per thousand (ppt)] areas of the Bay; site salinities actually range from 9 to 15 ppt. Water quality variables were uniform throughout the water column, showing no signs of stratification (water depths range from 2 to 9 feet). In some areas, turbidity was elevated, which was attributed to the continually eroding islands. Turbidity was monitored during construction of Phase I, and turbidity levels always remained below the limits [150 nephelometric turbidity units (NTU) instantaneous; 50 NTU monthly average] that MDE specified to be protective of aquatic life in the area.

Once in operation, discharges from the Poplar Island Environmental Restoration Project will be regulated by a monitoring plan requirement under MDE Water Quality Certification 96-WL-0728 that has monitoring requirements similar to those that are in place for HMI. The quality of the water discharged from the facility will be continually monitored and results will be reported to MDE quarterly. Similar to the program at HMI, but expanded to include evaluations of the created wetland habitat, monitoring of water quality and biological conditions outside the facility will also be conducted throughout the life of the project.

4.3.1 Tidal Data, Currents, and Salinity

The tide range is approximately 1.2 feet in the Tolchester area. In the larger Chesapeake Bay area, the mean range of tide is 2.8 feet at the Cape Henry Channel, 2.3 feet at the York Spit Channel, 1.4 feet at the Rappahannock Shoal Channel, 0.8 foot at the Craighill Entrance, 0.9 foot in the Craighill Upper Range, 1.1 feet at Fort McHenry, and 1.2 feet at Pooles Island in the upper Chesapeake Bay. Prolonged high winds from the north tend to blow water out of the Bay, resulting in unusually low tides, and prolonged high winds from the south tend to force water into the Bay, resulting in unusually high tides.

The velocity of the flood current varies in strength from a maximum of approximately 1.7 fps at the entrance to the Chesapeake Bay to about 1.0 fps at the Craighill Entrance Channel [National Ocean Service (NOS) 1996, 1997]. A vessel entering the Chesapeake Bay through the Virginia Capes at a speed of 20 fps (12 knots) can pass Cape Henry 2 or 3 hours prior to high tide and carry a favorable current all the way to Baltimore. A vessel leaving Baltimore at the same speed at high tide can carry a favorable current about two-thirds of the way to Cape Henry.

The salinity of the Chesapeake Bay ranges from highest at the mouth of Chesapeake Bay, where seawater enters the estuary through the Virginia Capes, to brackish water along the Susquehanna flats in the upper Bay. Salinity varies considerably throughout the Bay along longitudinal and depth gradients, as well as seasonally. The salinity of the Bay is significantly affected by periods of drought and heavy rains, and by unseasonably warmer temperatures. At Baltimore, the salinity varies from an average of 8 ppt in the spring to 12 ppt in the fall. The salinity at the mouth of the Potomac River varies from 11 to 18 ppt, while at Cape Henry it varies from 23 to 29 ppt.

<u>Tolchester Channel S-Turn</u>

Currents affecting the straightening area are generally caused by tides, fresh water runoff, and storm-induced surges. Since the Tolchester Channel is located in the upper

Chesapeake Bay, it is exposed to tidal currents and winds. Tides are semidiurnal (generally two flood tides and two ebb tides per day). Predicted tidal currents are generally aligned with the channel, reversing approximately 180 degrees during flood and ebb tide cycles. However, the existing Tolchester Channel changes direction several times within a short distance in the S-Turn so currents are likely to be oblique to the channel through part of the S-Turn. Tidal currents in the vicinity of the Tolchester Channel S-Turn have typical maximum velocities of 1.35 and 1.69 fps for ebb and flood currents, respectively. However, actual current velocities can frequently exceed this range of maximum velocities due to wind conditions. Storm-induced surges and heavy runoff during and following storm events will increase current velocities throughout the area.

The average tidal current predictions were used to model the predicted differences in current velocity rates as a result of straightening the Tolchester Channel S-Turn. *In situ* measurements of actual currents were made during April and May 2000 as a measurement of the pre-dredging current conditions in the Hodges and Swan Point Oyster Bars south of the S-Turn. The full set of results is included in Appendix VII. Current meters were deployed for 1 month (April through May 2000) at four locations in the Hodges and Swan Point Oyster Bars south of the S-Turn (see Figure 4-8). A summary of the current velocities is presented in Table 4-6. Comparison of these values to the predicted currents used for modeling potential differences in currents indicates that predicted currents are a good indicator of actual current conditions in the area. The measured values, therefore, support the prediction of only slight (less than 0.1 fps) differences in current velocity in the vicinity of the oyster bars as a result of the project (Section 4.1.5.4).

Table 4-6
Measured currents (fps) in the Hodges and Swan Point Oyster Bars
(24 April to 26 May 2000)

STATION*		FLOOD		EBB	
		East	North	East	North
1	Max.	1.072887	1.423954	-1.151631	-1.423954
	Min.	0.003281	0.003281	-0.003281	-0.003281
	Mean	0.326012	0.451111	-0.312806	-0.475568
2	Max.	1.010548	1.364896	-1.184441	-1.063044
	Min.	0.003281	0.003281	-0.003281	-0.003281
	Mean	0.329556	0.484206	-0.460374	-0.353845
3	Max.	1.361615	1.305838	-1.656905	-1.253342
	Min.	0.003281	0.003281	-0.003281	-0.003281
	Mean	0.434908	0.349191	-0.721813	-0.414843
4	Max.	1.023672	0.738225	-1.492855	-1.066325
	Min.	0.003281	0.003281	-0.003281	-0.003281
	Mean	0.367296	0.239721	-0.474694	-0.254332

*Stations run numerically from north to south in the Hodges and Swan Point Oyster Bars south of the S-Turn.

The water within the existing S-Turn and proposed straightening area is oligohaline-mesohaline, with salinity ranging from 3 to 9 ppt.

HMI

Tidal currents in the vicinity of HMI are similar but slightly less than those near the Craighill Entrance (1 fps, typical maximum) (NOS 1996, 1997) and similar to those at Poplar Island because HMI lies in an area that is somewhat removed from the mainstem of the Bay. Currents on the eastern side of the island would be most like the Bay, and the more protected area to the west may experience somewhat lower current velocities. Water depths adjacent to HMI on the Chesapeake Bay side average 15 feet. The water is oligohaline, with salinity ranging from 2 to 8 ppt.

Poplar Island

Tidal currents in the vicinity of Poplar Island range from a minimum of 0.2 fps to a maximum of 0.8 fps with the higher velocities occurring to the west (closest to the mainstem of the Bay) and the lowest velocities between the islands (USACE and MPA 1996). The waters adjacent to Poplar Island range from 2 to 9 feet. The water is mesohaline, with salinity ranging from 9-15 ppt.

4.4 AQUATIC RESOURCES

Tolchester Channel S-Turn

A variety of recreationally and commercially important fishes occur in the vicinity of the proposed S-Turn straightening area. These include striped bass, white perch, bluefish, channel catfish, American eel, spot, croaker, winter flounder, American shad, alewife, weakfish, and blueback herring. The area is not an important spawning area, although larvae of such species as bay anchovy, Atlantic silverside, and others may be present in low numbers in the water column during the summer. The area lies south of the important anadromous fish spawning areas in the Susquehanna River mouth and upper Bay tributaries, and south of the general finfish nursery area for juvenile Atlantic menhaden, bay anchovy, American shad alewife, white perch, striped bass, and blueback herring. Juvenile spot are reported to use the area in spring, summer, and fall (Funderburk et al. 1991). The area of the Bay that includes the straightening area is also reported to be a major summer concentration area for adult and juvenile striped bass and a nursery area for spot, croaker, and weakfish (Lippson 1973).

Due to the depths and substrate type, the only commercial shellfish that utilize the site are blue crabs. However, there are two productive natural oyster bars south of the existing S-Turn: NOB2-9 (Hodges Bar) and NOB5-1 (Swan Point Bar). Additionally, NOB3-3 (Tolchester Lump) lies just north of the current Tolchester Channel S-Turn alignment and NOB 2-5 lies within one-half mile of the proposed straightening area (to the west) (Figure 4-9). Blue crabs are fairly common in some seasons. However, the site is too deep to be very productive in warmer months (due to low oxygen levels) and probably is only an important harvest area when blue crabs are moving between the shallows and the deeper (overwintering areas) in spring and fall. Crabbing information for the Bay is recorded for very large areas and the actual utilization of the straightening area cannot be determined from the data. Within the area from Pooles Island to the Bay Bridge, 2,815,530 pounds of crab were harvested in 1999. The lowest harvests were in April (6,245 pounds) and the highest in September (771,904 pounds). No harvesting was conducted from December through March.

In the fall of 1995 and spring of 1996, juvenile crabs were unusually abundant within the turbidity maximum zone of the upper Bay. The Tolchester Channel S-Turn falls within this zone. Review of ongoing Chesapeake Biological Laboratory investigations on this subject revealed that juvenile crabs do occur within the turbidity maximum zone, but the abundance there in 1995 and 1996 was unusually high. The investigation revealed that, in normal years, juvenile crab abundance is much lower in this zone and much higher below the Chesapeake Bay Bridge. Initial dredging and maintenance dredging would be scheduled for the period of October 1 through March 31. This window overlaps with the fall period when juvenile crabs would be expected to be present.

The Baltimore District is currently conducting a study of recreational boating activities throughout the upper Bay using aerial photographs to estimate recreational use and potential fishing activity. Flights were made through last summer and early fall. Preliminary evaluations of the data from June-July 2000 indicate that approximately 34 to 50% of all boating activity in the upper Bay during early summer is probably engaged in fishing activities at any point in time. However, out of 459 to 1384 total boats in the upper Bay, only 158 to 676 boats observed were stopped and probably fishing in the photos that have been interpreted so far. Of those stopped, only 1 to 2 boats were observed within the Tolchester area, constituting less than 0.2% of the fishing activity at the time of the sample. Additionally, only up to 8 boats were observed motoring through or stopped within the Tolchester area in all photos interpreted to date. This constitutes between 0.2 and 1.7% of the total recreational boat traffic of the upper Bay on the days sampled (in early summer). The Tolchester area, so far, has exhibited the lowest boat utilization of all specific areas counted.

In the Bay, areas deeper than about 20 feet can experience low oxygen (hypoxia) in warmer months (late April through late September) and would be less supportive of aquatic life than shallower areas. Crabs and finfish selectively avoid hypoxic areas and low harvest rates have been found in deeper waters in summer (Funderburk et al. 1991). In years when temperatures are cooler than average, hypoxia is less widespread and areas deeper than 20 feet may be more productive. It is believed that the depths and oxygen conditions in the Tolchester area are probably not supportive of finfish or blue crab populations for parts of the summer.

The area is probably utilized by young finfish and crabs in cooler months but is not of sufficient depth to provide (warmer) overwintering habitat for young throughout the winter. In studies of the upper Bay for the potential development of an upper Bay island (EA 1997), the shallows to the north of the straightening area (near Gales Lumps, Figure

4-9) and along the edges of the existing Tolchester Channel S-Turn were identified as important recreational fishing areas, particularly for striped bass. This was reiterated in recent consultation letters from Charterboat Captains (Appendix I).

The area is of a depth that may support some overwintering blue crabs. Winter crab information for the S-Turn area and upper Bay was obtained from MDNR. Several general trends are apparent. The depth in the area to be dredged ranges from -23 to -28 ft MLLW. From 1992 through 2000, winter crab densities in depths less than 40 feet (in the upper Bay) ranged from 1.86 to 15.75 crabs per 1,000 square meters. This translates to approximately 1.61 to 12.17 percent of all crabs captured Baywide in those years and 0.001 to 0.0045 percent of all of the crabs estimated to be in the Bay during those years. Within the area proposed for straightening, densities were even lower than the upper bay average ranging from 0 to 13.97 crabs per 1,000 square meters. This would result in approximately 0 to 8,700 crabs that could be in the project area when work could begin or during maintenance periods. On average a similar-sized area of the upper Bay within this depth range (<40 feet) would contain 1200 to 9600 crabs.In the upper Bay, these would be predominantly males and juveniles.

Benthic studies were conducted in the project area by the Greeley Polhemus Group, Inc. (1994) for the National Environmental Policy Act (NEPA) documentation for the C&D Canal Deepening Study. Box coring was conducted in winter (December 1993) to characterize the benthic community during the typical time of dredging operations. Triplicate samples were collected from the proposed straightening area. The studies indicated that polychaete worms and amphipods dominated the community. Some Macoma clams were also collected. The samples were generally dominated by stess-tolerant species and no recreationally or commercially important species were collected.

HMI

HMI provides about 19,000 feet of reef-type habitat for the attachment of algae, seaweed, hydroids, molluscs, and crustaceans. The waters around HMI support spawning, nursery, adult feeding, migrant feeding, and life resident habitat for more than 27 species of fish. The site is not a recognized unique spawning or breeding ground for fish or shellfish. Fish species inhabiting the project area are shown in Appendix II. Depths surrounding the site are generally less than 20 feet and, therefore, support fish and shellfish through the warmer months. The outfalls are popular fishing areas. Pound-netting, gill-netting, and commercial crabbing do occur in the area. Based upon the depths and the location (because the data are summarized for a large area), the overwintering blue crab potential in the areas surrounding HMI would be the same as that stated for the straightening area. The nearest natural oyster bar (NOB2-3) lies more than a mile from the site. No soft clam resources occur in the area.

The HMI Exterior Monitoring TRC reported to MPA in January 1996 that, based on annual monitoring performed for 14 years at HMI, there has been no significant observed impact to the benthic community or to benthic populations surrounding the site. The HMI TRC also reported that a fluid mud layer was created as a result of the initial construction of the HMI perimeter dike. The mud layer was observed to extend from 525 to 1,090 yards from the perimeter of the facility. Changes in the benthic biota accompanied the occurrence of this mud layer. However, recovery of the benthic population was observed in subsequent years.

Poplar Island

Poplar Island lies within mesohaline waters and has predominantly sandy substrates. The waters surrounding the site are shallow and support a wide variety of finfish of various life stages. Previous studies of the site yielded more than 50 species throughout the year (USACE and MPA 1996). The Species List is included in Appendix II. Species composition was found to be typical of shallow mesohaline reaches of the Bay. The site was also found to provide nursery habitat for a variety of finfish. The shallows adjacent to the island are utilized as a refuge by young crabs and finfish. The three species of concern for essential fish habitat (bluefish, summer flounder, and winter flounder) were collected as early life stages and/or young in the vicinity of Poplar Island. No rare, threatened, or endangered fish species were collected.

Four commercially important shellfish species (oysters, blue crabs, soft clams, and razor clams) occur in the upper and mid-Bay near Poplar Island. Oyster bars (NOB 8-10, 8-11, and 11-2) surround the project (Figure 4-10). NOB 8-10, located west of Poplar Island, is of particular concern to resource agencies because it is among the bars that are seeded for restoration of the resource. The nearest spillway is located at the northern end of Poplar Island and is approximately 500 yards from the oyster bar. Razor and soft clams are harvested adjacent to the islands. Blue crabs are heavily harvested throughout the area. The area is also commercially harvested (pound-netted) for striped bass, Atlantic menhaden, and other herrings. Recreational angling occurs around the site, particularly trophy fishing for striped bass.

Winter crab surveys of the middle Bay (Bay Bridge to Poplar Island) from 1992 through 2000 indicated that the overwintering crab densities for water depths less than 40 feet ranged from 2.46 to 20.11 crabs per 1,000 square meters (the Poplar Island area ranges in depth from 2 to 9 feet). Also, higher densities of crabs were consistently found in less than 40 feet of water in this reach than at other depths. Such a trend was not apparent in the upper Bay (north of the Bay Bridge) during this period.

4.4.1 Essential Fish Habitat (S-Turn, HMI, and Poplar)

The Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA) (16 U.S.C. 1801) requires that Federal agencies consult with the National Marine Fisheries Service (NMFS) regarding any action or proposed action authorized, under, or undertaken by the agency that may adversely affect Essential Fish Habitat (EFH) identified under the Act. The Tolchester S-Turn and proposed straightening area lie within the general reach of EFH for bluefish, winter flounder, and summer flounder. Although Poplar Island and HMI also lie within the general reach, no EFH exists within the placement sites. A general analysis of impacts on each species is included in Section 5.

4.5 VEGETATION

Tolchester Channel S-Turn

There is no terrestrial vegetation, submerged aquatic vegetation (SAV), or wetlands within the existing or proposed channel or adjacent to the channel. Because of the water depths in the area (-23 to -28 feet), it is not likely that SAV could establish in the channel area. The closest SAV to the project area is in Tavern Creek, east of Swan Point. This is over 3 miles from the project site and separated from the site by Swan Point.

HMI

Pines (*Pinus* sp.), sycamore (*Platanus occidentalis*), maple (*Acer* sp.), willow oak (*Quercus phellos)*, eastern red cedar (*Juniperus virginiana)*, and sweetgum (*Liquidambar styraciflua*) have been planted around the dikes, as have coastal panic grass (*Panicum amarum*), switch grass (*Panicum virgatum)*, and weeping lovegrass (*Eragrostis curvula*). The dredged material at HMI in the South Cell has been actively dewatered since 1990, when the last dredged material was received. The North Cell undergoes periodic dewatering, but is still receiving annual inflow of dredged material and is not vegetated. Common reed (*Phragmites communis*), which colonizes disturbed soils, is established at the HMI South Cell. This species is not considered good habitat because of its thick underground and aboveground growth. However, it provides cover, a small amount of food resources, and contributes to water quality benefits. *Phragmites* control measures have been initiated by MPA with some success. This has allowed some other vegetation to colonize the South Cell.

The Hart Island portion of the State Park consists of two tracts of upland deciduous forest equaling 26 acres. Approximately 45 acres of wetlands are also located around the two tracts of forest on Hart Island. This wetland, and areas around it, have been invaded by *Phragmites* and bindweed (Polygonum *convolvulus*). MPA has recently initiated efforts to control *Phragmites* in this area, and to plant native wetland species. Beach and shoreline habitat are also found around the edges of Hart and Miller Islands, as well as between the two islands, where a sandy beach has been constructed as part of the State Park.

No SAV beds are known to exist adjacent to the facility based on recent VIMS surveys (1999).

Poplar Island

The Poplar Island site is currently being constructed and put into operation. Few terrestrial plants currently exist on the remnant islands. Some wetland plants were preserved on the remnant islands and are still living within the diked area. These will be preserved to help revegetate the wetlands cells after reconstruction.

The proposed wetland cells at the Poplar Island restoration site are not expected to support SAV once they have been constructed. The closest existing SAV bed to Poplar Island is located on the Eastern Shore in Harris Creek (based on VIMS surveys, 1999). It is composed of the species horned pondweed (*Zannichellia palustris).* SAV surveys of the site during pre-construction surveys (in 1996) discovered several species of SAV washed up on Coaches Island. Widgeon grass (*Ruppia maritima*), horned pondweed, and water milfoil (*Myriophyllum spicatum*) were found growing approximately 300 yards east of the project. All were found in very low densities in small patches which have not been observed since. No SAV were found prior to the start of construction of Phase I in 1998. SAV beds previously existed in Poplar Harbor, east of the site. It is hoped that SAV will re-establish as a result of the Poplar Island construction, which will reduce wave energy in Poplar Harbor.

4.6 WILDLIFE RESOURCES

Tolchester Channel S-Turn

The straightening area is completely aquatic, so few terrestrial wildlife resources are expected on the site. Raptor, gull, and waterfowl species are expected to be transient users of the site. There are no nesting opportunities within or immediately adjacent to the site, although the Tolchester Beach area (approximately 1/2 mile from the project) is known to support a variety of raptor species, blackcrown night herons, and waterfowl. The depths at the site (-23 to -28 feet) do not support SAV, so wading birds (heron/egrets), most waterfowl species, and shorebirds would not have foraging opportunities. The depths would generally preclude use by diving/sea ducks. Gulls and terns are expected to be transients at the site.

Many areas of the upper Bay are designated Historic Waterfowl Concentration Areas. A Historic Waterfowl Concentration Area is defined as an area of open water and adjacent marshes where waterfowl gather during migration and throughout the winter season [Code of Maryland Regulations (COMAR) 27.02.01.01]. The straightening site is in open water more than 1,000 feet from shore and thus would not be a significant waterfowl concentration area, although it may be used intermittently by rafting flocks as would the existing channel area.

HMI

In the northern portion of the Chesapeake Bay, one of the most limited avian habitats for wintering waterfowl is shallow-water habitat. Shallow-water and mudflat habitat is limited for migratory shorebirds. Over the years, HMI has been proven to be a significant provider of these types of habitats. At times during the operation of this facility, as many as 20,000 waterfowl have been observed using the facility. There have been significant nesting and rearing activities, which, with some operational variation and difficulty, were protected from operational impact. The mudflats and ponds at the site are a valuable resource for shorebirds.

HMI has attracted more than 235 observed species, including least tern, great blue heron, Canada goose, northern pintail, blue-wing teal, northern shoveler, canvasback, scaup, mallard, ruddy duck, and others (Ringler 1992). The Maryland Ornithological Society has stated that the facility at times has supported the largest single concentration of waterfowl in the Mid-Atlantic Region. Birds identified from 1977 to 1999 are listed in Appendix II. A colony of approximately two dozen great blue herons is reported at Hart-Miller State Park. Occasionally a bald eagle is sighted, although eagles are not known to nest at HMI. Barn owls, ospreys, and saw-whet owls are other raptors that have been identified at the site.

Mammals at HMI include red fox, muskrat (Hart Island only), raccoon, occasional (transient) white-tailed deer, and field mice. Reptiles reported at the site include water snakes [*Natrix* (sp.)], black snakes, and snapping turtle. HMI is a resting-place for monarch butterflies in their annual migrations.

Poplar Island

Lists of the terrestrial wildlife that were found on the remnants of Poplar Island during pre-construction surveys can be found in Appendix II. The Poplar Island site is currently being constructed and brought into operation, so terrestrial wildlife species potentially using the site are most likely limited. Gulls and other transient seabirds, wading birds, waterfowl, and shorebird species use the site and adjacent remnant islands on a limited basis now. This usage is expected to increase as the ponds within the site become established. Nearby Coaches Island and Jefferson's Island are utilized by avian and terrestrial wildlife species. An active bald eagle nest was located on nearby Jefferson Island, but the eagle recently relocated to Coaches Island. Coaches Island supports a great blue heron population, egrets, and a white-tailed deer population. The neighboring avian residents may occasionally use the restored Poplar Island during the construction process and are expected to help populate the island over time.

4.7 RARE, THREATENED, AND ENDANGERED SPECIES

The Endangered Species Act directs all Federal Departments/Agencies to carry out programs to conserve endangered and threatened species, in consultation with the Secretary of the Interior or Commerce, and to preserve the habitat of such species.

Tolchester Channel S-Turn and HMI

USFWS has indicated by letter dated July 9, 1996 that, except for occasional transient individuals, there are no Federally listed endangered species in the proposed Tolchester Channel realignment and Hart-Miller Island area. Peregrine falcons have been consistently observed nesting in downtown Baltimore at the Inner Harbor. A pair of falcons nest less successfully on the Francis Scott Key Bridge. Their diet generally consists of pigeons, but they occasionally will prey on various waterbirds. A bald eagle nest site is located in the vicinity of Black Marsh near the mouth of Back River. Black Marsh is approximately 3 to 4 miles from HMI and 8 miles from the dredging area. Bald eagles feed primarily on fish; however, neither species is expected to be affected by the proposed project. Coordination with the State of Maryland has indicated that there are no State listed species of concern in the straightening area.

More recent coordination with USFWS and NMFS (1997 to 2000) on dredging and placement projects in the upper Bay has cited shortnose sturgeon (SNS) (*Acipenser brevirostrum*), a Federally listed endangered species, as a concern within the Bay. USFWS also cited wild Atlantic sturgeon (*Acipenser oxyrhynchus*), which has been recorded in the area, as a species of concern. Atlantic sturgeon are not listed as a RTE species. The most recent consultations for this project were with NMFS in May 2000 (Section 6). In November 2000, USACE submitted an Interim Biological Assessment and results of the USFWS reports (detailed below) to NMFS for consideration.

In 1996, USFWS initiated a Reward Program for incidental catches of sturgeon in commercial gear. Due to an increased number of SNS captured during the USFWS Reward Program in the Chesapeake Bay in 1996 and 1997, NMFS requested that USACE prepare a Biological Assessment (BA) of the potential impacts of dredging and dredged material placement operations in the upper Chesapeake Bay on SNS.

In 1997, USFWS and USACE initiated sampling programs in the vicinity of the existing dredged material placement sites at Pooles Island, near proposed upper Bay Island sites (one located just west of the proposed straightening area), within several old placement areas, and within the mainstem channels, including two locations within the existing Tolchester Channel. This field component was completed in June 2000. As of fall 2000 gill nets had been deployed for more than 170 hours immediately south and west of the straightening area and for more than 318 and 459 hours in the southern and northern sections of the existing Tolchester Channel. No SNS were captured within the area during that time. The U.S. Fish & Wildlife Service documented its findings in *A Report of Investigations and Research on Atlantic and Shortnose Sturgeon in Maryland Waters of the Chesapeake Bay (1996-2000)* (Skjeveland 2000). The final BA will be submitted upon completion of the data analysis from this 2.5-year study. This field component of this study was extended until June 2001. Data analysis is ongoing.

As of March 2001, no SNS have been captured within the proposed straightening area. One SNS was captured just south of the Tolchester area in December 2000. Two SNS were captured in the northern vicinity of the existing HMI facility in January and February 1999, respectively, in gill nets (Figure 4-11). The HMI vicinity was not sampled as part of the USFWS/USACE study. Wild Atlantic sturgeon (which are not a listed species) have been reported near both the straightening area and HMI from Reward Program captures (Figure 4-12). One Atlantic Sturgeon was captured northeast of HMI and two were captured in the vicinity of the existing S-Turn and straightening area.

Preliminary genetic analysis from the study suggest that it is likely that the SNS specimens analyzed from the Delaware River and the Chesapeake Bay were part of the Delaware River's stock that extends into the Chesapeake Bay (Grunwald et al. 2000). An Interim BA that includes this data was submitted to NMFS in November 2000; NMFS is currently reviewing the document.

<u>Poplar Island</u>

Rare, Threatened, and Endangered Species (RTE) consultations were made in 1996 for the Poplar Island Environmental Restoration Project. At the time, the only Federally listed species of concern at the site was the bald eagle nesting on Jefferson Island. Construction buffers of 0.25 mile) from the nest were established for the breeding season. One bald eagle nest was established on Coaches Island in 2000. Although the 1996 consultation acknowledged that SNS occurred within the Bay, NMFS did not believe that Poplar Island would be utilized by the species. No recent SNS or Atlantic Sturgeon captures have been made in the area as part of the Reward Program near Poplar Island (Figures 4-12 and 4-13). Poplar Island was not one of the areas sampled during the USFWS/USACE study.

4.8 FLOODPLAINS

Both of the proposed placement areas are located in the 100-year floodplain.

4.9 PRIME AND UNIQUE FARMLANDS

There are no prime or unique farmlands in the straightening area or at either of the placement sites.

4.10 WILD AND SCENIC RIVERS

No National or State-designated wild and scenic rivers or river segments are located within the project area.

4.11 CULTURAL RESOURCES

Tolchester Channel S-Turn

Prehistoric archaeological sites have been documented in the region along the bluffs of the Bay shorelines, near lagoons, and along river and creek channels. European exploration began as early as 1570 with the Bay serving as highway to exploration and settlement. Shipwrecks were fairly common, particularly in shallow areas adjacent to the main channel (old river bed). In 1979, the Baltimore District conducted a Phase I investigation of the Baltimore Harbor & Channels 42-foot project to deepen and widen the Brewerton Channel Eastern Extension, Tolchester Channel, and Swan Point Channel to 35 feet deep and 600 feet wide (Koski-Karrell 1979a). One highly probable target was identified in the Tolchester Channel. An underwater cultural investigation was undertaken (Koski-Karrell 1979b) and the target was determined to be associated with modern iron debris which was subsequently removed.

As part of the NEPA documentation for the C&D Canal Deepening, cultural investigations were conducted along the general alignment of the Tolchester Channel and proposed straightening area (Goodwin and Associates 1992). A Phase I remote sensing investigation was conducted within the Tolchester Beach reach of the Channel and within the straightening area (Goodwin and Associates 1995a). Three magnetic anomalies were found in the Tolchester Beach Reach, but all were associated with modern debris. Within the proposed straightening area, two magnetic anomalies were identified in the upper part of the bend (proposed channel) and six were identified in the lower part of the proposed channel. All except one were attributed to modern debris or natural channel features. Phase II remote sensing and underwater investigations were conducted by Tidewater Atlantic Research, Inc. of the one anomaly that exhibited characteristics of a shipwreck (Tidewater Atlantic Research, Inc. 1996). The target was identified as a disturbance from previous dredging activities and an anchor chain from a buoy. Therefore, no significant cultural resources were identified in the vicinity of the proposed S-Turn realignment. The Maryland Historical Trust (MHT) has indicated, by letter dated June 27, 1996, that the proposed dredging represents no significant threat to submerged cultural resources, and additional archaeological investigations are not required. A MHT March 22, 2000, letter indicates that the proposed straightening of the S-Turn had the potential to adversely affect cultural and historic resources. The MHT requested that the Corps conduct a Phase I archaeological survey of the area. Since the Corps has already conducted Phase I and II archaeological investigations in the proposed straightening area as stated above, no further investigations were required (Langley letter of April 5, 2001, Appendix I).

HMI

The Maryland Historical Trust (MHT) indicated that the proposed project would present an insignificant threat to submerged cultural resources. Cultural investigations for HMI have indicated that use of the site would produce no significant adverse impacts to cultural resources. Since the site is now disturbed, it would have no archaeological value.

Poplar Island

Consultations with MHT were conducted as part of the NEPA documentation for the construction of this site (Goodwin and Associates 1995b). Because the site had been known to have a long history of shipwrecks, and significant historical resources once occurred on Poplar Island, Phase I and Phase II marine archaeological investigations were undertaken. Although several anomalies were identified by magnetometer and radio-acoustics during Phase I investigations, Phase II investigations indicated that none of the anomalies were of archaeological or historical significance. Construction at the site has already disturbed the area, and use of the site for dredged material placement should involve no cultural or historical resources. The State Historic Preservation Officer concurred with this determination in 1999.

4.12 HAZARDOUS, TOXIC, AND RADIOACTIVE SUBSTANCES

Tolchester Channel S-Turn, HMI, and Poplar Island

USACE regulations require documentation of the existence of Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) and National Priorities List (NPL) sites within the boundaries of a proposed project that could impact, or be impacted by, the presence of Hazardous, Toxic, and Radioactive Substances (HTRS) contamination. USACE Engineer Regulation (ER) 1165-2-132 provides that dredged material and sediments beneath navigable waters proposed for dredging qualify as HTRS only if they are within the boundaries of a site designated by EPA or a state for a response action, such as removal or remediation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Information about potential HTRS contamination was collected from several sources. These sources include a search of Federal and state environmental databases for CERCLA and Resource Conservation and Recovery Act (RCRA) sites. The results of these investigations indicate that there are no RCRA or CERCLA sites in the HMI or Poplar Island areas or in the immediate vicinity of the proposed straightening.

The Nike Missle Battery BA-30/31 was a former Army base from 1954 to the 1960s and is located approximately 3,000 feet inland from Tolchester Beach in Kent County, Maryland. Tolchester Beach is approximately 1,000 feet from the closest reach of the existing Tolchester Channel. Solvents such as degreasers have been identified at the Nike site. The contaminant of concern found at the site is trichlorethylene (TCE). TCE is a chlorinated organic solvent that has been widely used for the past 50 years. TCE and its degradation products are classified as priority pollutants and are on USEPA's (1985) list of hazardous substances. Sampling activities conducted during 2-3 April 1996 by USACE Baltimore District were primarily focused on the Launch Area (USACE 1997b).

A Remedial Investigation (RI) Report dated November 1997 was prepared by Baltimore District. Results of the sampling activities showed that monitoring well #3 (MW-3) had 17 parts per billion (ppb) of TCE (regulatory level for TCE is 5 ppb), and that monitoring well #6 (MW-6) had 1.4 ppb of total petroleum hydrocarbons (TPH). The regulatory level for TPH is site-specific; however, this detection was less than the concentrations in the background well in 1986. Based on the data gathered during the RI, no further action is recommended for the TPH plume. TPH was not detected in any of the soil, groundwater, surface water, or sediment samples collected during the RI. The contamination appears to be limited to low concentrations of dissolved TPH around MW-6, and is not migrating. The low concentration of dissolved TPH–Diesel Range Organics (DRO) does not exceed a level that would pose a risk to human populations. It has been shown that TPH is readily biodegradable by native microorganisms at various sites and, therefore, no remedial action for the TPH is recommended.

Baltimore District recommended that a focused feasibility study be prepared for the TCE groundwater plume. Based on the existing data, the TCE plume appears limited to the zone directly below the water table and does not vertically extend over a large distance. This observation, in addition to the low levels of dissolved TCE, suggests that a continuing source of contamination does not exist. The TCE plume is small and has not impacted the nearby unnamed creek that empties into a small lake which is connected to the Chesapeake Bay by a narrow inlet. The lake and portions of the creek are tidally influenced. The highest detection for TCE onsite was a level of 94.7 ppb, while TCE offsite was detected at a level of 11 ppb. Since the offsite contamination (11 ppb) exceeded the maximum contaminant level (MCL) of 5 ppb for TCE, Baltimore District is recommending a focused feasibility study. In summary, Baltimore District has determined that (1) the TCE plume is small in size and has not impacted the unnamed creek; (2) the risk assessment showed no risk to human populations; (3) based on analytical data from approximately 10 years, the TCE plume appears to have stabilized and is not expanding; and (4) TCE exists offsite at concentrations above MCLs due to onsite contamination.

A supplemental Remedial Investigation/Feasibility Study (RI/FS) was completed in 1999. The Feasibility Study (FS) recommends that monitored natural attenuation be selected as the preferred remediation alternative. The proposed plan for monitored natural attenuation was released for a 30-day public comment period on March 1, 2000. A public meeting to review the proposed plan was held on March 14, 2000 at the Chestertown Public Library. Subsequent public interest in the project resulted in a briefing to Congressman Wayne Gilchrest (1^{st} District, Maryland) on April 18, 2000. The public comment period was also extended to May 8, 2000.

After consideration of comments received during the public meeting and public review period, a draft Decision Document was prepared. The Decision Document and a Long-Term Monitoring (LTM) Plan are now undergoing final review by Kent County and the Maryland Department of Environment (MDE). A contract to perform the initial two-year period of groundwater LTM sampling and laboratory analysis at the former launch facility was awarded on September 29, 2000. The Decision Document and LTM Plan are scheduled for release to the public in March 2001. A public information workshop to discuss these documents will be held in April 2001.

A contract to remove underground storage tanks was awarded on 30 September 2000. Fieldwork to remove these tanks was completed on 6 December 2000. A total of 9 tanks were removed (3 in the Launch Area and 6 in the Control Area). All contaminated soil identified during tank excavation was also removed from the site. No contaminated soil remains at the former tank locations. Formal acceptance of the tank closure report by MDE is pending. Additionally, closure of six underground missile silos (all located in the Launch Area) is programmed for FY 2002; however, execution of this project is subject to availability of funding.

Sediments to be dredged from the proposed realignment of the Tolchester Channel S-Turn, as well as from the existing Tolchester Channel, do not indicate the presence of HTRS, and it is unlikely that contamination from the Nike site has accumulated in the channel.

4.13 INFRASTRUCTURE

Tolchester Channel S-Turn, HMI, and Poplar Island

The study area is centered in one of the nation's most comprehensive transportation networks along the Eastern Seaboard. Three major airports serve the region, offering a variety of commuter, national, and international flights. Major rail service is provided primarily by CSX Transportation, Norfolk Southern, and Amtrak, while commuter service to and from Washington is provided by the State of Maryland through its commuter rail service (MARC). Light rail systems in the Baltimore area together with two major and modern subway systems in the Baltimore and Washington, D.C. areas provide efficient and convenient means of commuter transport. The study area includes a safe, efficient, and extensive network of interstate roads and highways including I-66, I-97, I-95, I-81, I-83, I-70, I-270, the Washington Beltway (I-495), and the Baltimore Beltway (I-695). U.S. Route 50/301 and the William Preston Lane Memorial Bay Bridge connect the mainland to the Delmarva Peninsula. These highway systems are used extensively by approximately 5,000 private truck haulers and independent common and contract haulers within the study area. The Port of Baltimore has container-handling and auto-handling facilities as well as facilities for loading and unloading a full range of bulk and general commodities. The Federal navigation channels that serve the Port are an important part of the regional infrastructure.

4.14 SOCIOECONOMIC CONDITIONS

Since its founding in 1706, the Port of Baltimore has been a major impetus of growth and economic development. This influence has been, and continues to be, manifested not only at a local and regional level but at the national level as well. The Port of Baltimore's influence extends beyond the boundaries of the State of Maryland to the Midwest, north into the Canadian provinces, and beyond the Atlantic Coast to the Port's European and Asian trading partners. The Port is located in the center of the Boston-Atlanta Corridor on the Atlantic Seaboard. Maryland is the 19th most populous state in the nation and exhibits a per capita income that is the 5th highest in the nation (Maryland

Department of Planning, Planning Data Services). More than 81 percent of Maryland’s 5.2 million residents live in the Baltimore-Washington corridor (2000 estimate).

In recent years, MPA has worked towards maintaining the Port of Baltimore as a thriving world-class port. Since 1980, more than one-half billion dollars has been invested in maritime-related improvements. The Port of Baltimore handled over 40 million tons of commerce in 1998. As the commercial shipping industry continues to grow, the Port of Baltimore is anticipated to expand to meet the demands of the market.

4.14.1 Demographics

In 1993, the Office of Management and Budget (OMB) designated the Washington and Baltimore Metropolitan Areas as the country’s fourth largest Consolidated Metropolitan Statistical Area (CMSA), ranking behind only the New York–New Jersey CMSA; the Los Angeles-Riverside-Orange County CMSA; and the Chicago-Gary-Kenosha CMSA. The 1999 estimated population statistics indicate that the Baltimore Metropolitan Area had a total population of 2,450,566 while the Maryland Suburbs of Washington, D.C. had 1,824,824. Together, these levels represent more than a 3 percent increase over 1990 levels. The upper Eastern Shore (Caroline, Cecil, Kent, Queen Anne's, and Talbot Counties) had a total estimated population of 207,703 in 1999 but demonstrated nearly 8 percent growth over the period 1990 to 1999. The available regional demographics for Maryland have been summarized in Table 4-7.

Table 4-7
Regional Demographic Statistics

County	Total Population			Minority Population*		
	1990[1]	1999 (Estimated)	2005 (Projected)	1990 Minority Population	1990 No. of Individuals Below Poverty Level	1990 Minority Individuals Below Poverty Level
Anne Arundel	427,239	480,483	501,000	61,634 (14.4%)	17,423 (4.4%)	6,787 (1.7%)
Baltimore	692,134	723,914	742,000	103,510 (14.9%)	34,298 (5.8%)	10,113 (1.7%)
Baltimore City	736,014	632,681	633,100	448,081 (60.9%)	153,413 (48.8%)	121,177 (38.5%)
Calvert	51,372	73,748	85,000	8,558 (16.7%)	2,542 (5.3%)	42 (1.7%)
Cecil	71,347	84,238	88,700	3,843 (5.4%)	2,951 (7.7%)	661 (1.0%)
Charles	101,154	120,946	136,600	20,902 (20.7%)	4,808 (5.1%)	2,501 (2.6%)
Dorchester	30,236	29,709	30,600	8,646 (28.6%)	3,970 (15.5%)	2,458 (9.6%)
Harford	182,132	217,908	239,500	19,635 (10.8%)	8,639 (5.1%)	2,335 (1.4%)
Kent	17,842	19, 089	19,800	3,649 (20.5%)	1,776 (11.9%)	701 (4.7%)
Prince George's	722,705	781,781	825,900	414,709 (56.9%)	40,259 (6.0%)	27,390 (4.1%)
Queen Anne's	33,953	40, 688	44,750	3,993 (11.8%)	2,235 (6.0%)	736 (2.0%)
Somerset	23,440	24,236	25,500	924 (3.9%)	2,974 (18.0%)	1,692 (10.2%)
St. Mary's	75,974	88,758	88,758	11,376 (15.4%)	5,215 (7.7%)	1,879 (2.8%)
Talbot	30,549	33,550	33,550	5,697 (18.6%)	2,333 (8.5%)	1,271 (4.6%)
Wicomico	74,339	79,560	79,560	17,534 (23.5%)	7,739 (12.3%)	4,140 (6.6%)

1 Based on U.S. Census Bureau Population Estimates from 1990 census
* Based on MD Dept of Planning, Planning Data Services data from 1990 census data

Tolchester Channel S-Turn

The proposed Channel straightening lies closest to Kent County, but is also in proximity to Queen Anne's County. Kent County had a population of 17,842 in 1990 with a projected growth rate of 11 percent from 1990 to 2005. Queen Anne's County had a population of 33,953 in 1990 with a projected growth rate of approximately 32 percent for the period 1990 to 2005. As a percent of the total population in each county in 1990, the total minority population was greatest in Kent County (20.5 percent), followed by Queen Anne's County (11.8 percent). Kent County also had a higher percentage of individuals below the poverty level with 11.9 percent versus Queen Anne's County with 6.0 percent.

HMI

Hart-Miller Island lies within Baltimore County and is close to the Harford County/Aberdeen Proving Ground (APG) boundary. In 1990, the population of Baltimore County was 692,134 with a projected growth rate of 7 percent for the period 1990 to 2005. The county supports a relatively moderate minority population (14.9 percent) with 1.7 percent of minorities living below the poverty level. Harford County has a moderate-sized population (182,132 estimated in 1990) and is projecting 31 percent growth by 2005. Harford County supports a relatively moderate minority population (10.8 percent) with only a small percentage living below the poverty level (1.4 percent).

Total populations living below the poverty level were 5.8 and 5.1 percent for Baltimore and Harford Counties, respectively.

Poplar Island

Poplar Island lies within Talbot County, which had a population of 30,549 in 1990 and an estimated population of 33,550 in 1999. A 10 percent growth is projected for 1990 to 2005. The percentage of minority population of Talbot County is somewhat higher than neighboring Queen Anne's County (18.6 versus 11.8 percent, respectively), as is the percentage of minorities living below the poverty level (4.6 versus 2 percent, respectively). Total populations living below the poverty level were 8.5 and 6.0 percent for these two counties, respectively.

The jurisdictions of Baltimore City, Baltimore County, and Anne Arundel County immediately adjacent to the Port will likely experience more positive direct economic impacts of Port success than the suburban jurisdictions of Washington, D.C. or the upper Eastern Shore. Baltimore City has the highest minority population and highest percentage of the population living below the poverty level of all jurisdictions. It is the only area that is predicting a population decline by 2005.

4.14.2 Employment/Industry

In 1999 job growth in Maryland (2.5 percent) exceeded the national rate (2.2 percent). Based on 1995 estimates, the total State employment rate is more than 70 percent. The most recent available employment statistics for Maryland are summarized in Table 4-8. These statistics do not effectively capture self-employment percentages (such as farming and fishing).

Table 4-8
Income and Employment Statistics

County	Median Household Income in 1990	1997 Employment*			
		Government	Retail Trade	Services	Manufacturing
Anne Arundel	$45,147	22,879 (17.8%)	39,650 (22.9%)	48,000 (27.7%)	15,252 (8.8%)
Baltimore	$38,837	49736 (14.7%)	72,158 (21.2%)	107,357 (31.9%)	36,666 (10.8%)
Baltimore City	$34,612	56,338 (22.2%)	43,883 (11.5%)	139,040 (36.4%)	31,209 (8.2%)
Calvert	$47,608	2,550 (16.9%)	3,886 (25.7%)	3,914 (25.9%)	655 (4.3%)
Cecil	$36,019	4,420 (20.6%)	4,660 (22.8%)	3,928 (19.2%)	3,360 (16.4%)
Charles	$46,415	7,143 (21.5%)	10,967 (33%)	6,382 (19.2%)	1,256 (3.8%)
Dorchester	$24,922	1594 (14.1%)	1,768 (15.7%)	2,198 (19.5%)	3,733 (33.0%)
Harford	$41,680	16,360 (26.9%)	14,401 (23.7%)	13,372 (22.0%)	4,121 (6.8%)
Kent	$30,104	862 (12.0%)	1,345 (31.4%)	2,248 (43.4%)	946 (13.2%)
Prince George’s	$43,127	67949 (23.5%)	64,677 (22.4%)	75,650 (26.2%)	11,213 (3.9%)
Queen Anne’s	$39,190	2000 (18 %)	4100 (31%)	4000 (30%)	1000 (10%)
Somerset	$23,379	2463 (41.3%)	1,025 (16.8%)	780 (12.8%)	460 (7.5%)
St. Mary’s	$37,158	8663 (30.1%)	5,651 (19.6%)	8,899 (30.9%)	533 (1.8%)
Talbot	$31,885	1500 (8.9%)	3,674 (21.8%)	5,886 (34.9%)	2,656 (15.7%)
Wicomico	$28,512	5341 (13.6%)	8,086 (20.7%)	10,545 (26.9%)	7150 (18.3%)

*Based on MD Dept of Planning, Planning Data Services data from 1997 income tax data

One of the largest employers and revenue producers in the region is the Port of Baltimore. A recent analysis of job creation by the Port indicates that nearly 126,000 jobs are directly or indirectly tied to commodity movement and vessel activity in the Port (Martin Associates 1999). Slightly more than 50 percent of these jobs are held by Maryland residents and nearly 18,000 are jobs directly generated by (and wholly dependent upon) activities at the Port of Baltimore. Revenue generated by the movement of cargo and vessels through the Port is estimated to have been $1.4 billion in 1998. This estimate is based on revenues accruing to various sectors including maritime services, surface transportation, State and Federal governments, and financial and legal services.

Tolchester Channel S-Turn

In Kent County (in 1997), the majority of individuals (43 percent) were reported to work in various service industries, while 31 percent were involved in retail. Government employment and manufacturing made up only 12 and 13.2 percent of the workforce, respectively. The 1995 estimates for the upper Eastern Shore indicated that only 3.2 percent of the total population was involved in agricultural services, forestry, or fishing. In Queen Anne’s County, approximately 30 and 31 percent of the population were reported as employed in services and retail, respectively. Manufacturing and government employment comprise 10 and 18 percent of the total job market, respectively.

HMI

In Baltimore County, jobs in the service industry dominated the employment percentages (32 percent). Retail comprised 21.2 percent while government employment and manufacturing comprised approximately 15 and 11 percent, respectively. The employment statistics for Baltimore City paralleled those of the county with slightly higher government and services and slightly lower retail and manufacturing statistics. The 1995 estimates for the Baltimore Region indicated that 16.7 percent of the total population was involved in agricultural services, forestry, or fishing. In Harford County, fairly equal percentages of the population are involved in government work, retail, and services (27, 24, and 22.5 percent, respectively). Manufacturing comprised only 7 percent of the jobs in 1997.

Poplar Island

The majority of the jobs in Talbot County in 1997 were in the services industry (35 percent). Retail comprised 22 percent of the jobs while government and manufacturing jobs comprised only 9 and 16 percent, respectively.

4.14.3 Schools, Libraries

Tolchester Channel S-Turn, HMI, and Poplar

More than 1.5 million students attend the region's public and private elementary and secondary schools. As one of the United States' leading academic centers, the Washington-Baltimore CMSA is home to more than 60 colleges and universities and to more than 250 trade and technical schools, each capable of meeting the educational and research needs of employers in the region including growth, service, and technical companies.

More than 80 percent of the adult population in the Washington-Baltimore CMSA are high school graduates. Nearly 32 percent of the adult population hold college degrees, which is the highest percentage in the country and nearly twice the national average. Moreover, 5 of the 10 counties in the United States with the highest educational achievement are located in the Washington-Baltimore CMSA.

4.14.4 Noise

Tolchester Channel S-Turn

The noise in the existing Tolchester Channel S-Turn is predominantly generated by ships, tugs, and other vessels using the channel, and dredges and tugs during periodic maintenance dredging episodes, and is considered minor. Straightening of the Tolchester Channel S-Turn would move the channel further from shore, which is expected to slightly reduce the noise reaching land.

HMI

Noise at HMI originates from construction equipment onsite, hydraulic unloaders at the island, tugs transporting scows to and from the site, and crew boats carrying personnel to and from the site. Noise also emanates from recreational boat traffic around the site and recreational use of Hart-Miller Island. Citizen concern regarding noise is based on noise from boats carrying project crews to and from the site. Tests indicate that the noise is within recognized safety levels.

Poplar Island

Noise levels at the Poplar Island site, while not specifically measured, can be attributed to natural processes such as wave action, wind, and wildlife that may frequent the area. The site attracts birds, which add to the natural background noise levels. In addition to natural noise sources, there is commercial and recreational boat traffic in and around the site. Dike construction and dredged material placement operations at the site will create noise from truck engines, tugs, dredging equipment, crewboats, and back-up warning signals. Earth-moving equipment for dike construction is an additional source, as well as the engines of launches going to and from the mainland several times each day. Once the site begins to accept material, noise will also originate from equipment onsite, unloaders stationed at the island, and from tugs transporting scows to and from the site.

4.14.5 Aesthetic Resources

The visual experience in both the straightening area and at the placement sites is a combination of the activities of a typical commercial/industrial port and the natural beauty of the Chesapeake Bay.

Tolchester Channel S-Turn

Many container vessels, tankers, bulk carriers, general cargo vessels, and many smaller commercial and recreational vessels move around the harbor and channels. The S-Turn is located in an area of open water within the immediate viewshed of Tolchester Beach. The current view is one of open Bay expanses with intermittent ship traffic, tugs, and commercial and recreational watercraft.

HMI

Prior to construction of the HMI facility, citizens expressed concerns that the project would block their view of the Bay and have a potentially adverse impact on aesthetic resources in the area. This issue is still a concern to individuals and to citizens groups. To make the site more attractive, MPA is committed to planting and landscaping. Mooring of the hydraulic unloader and the movement of tugs, barges, and other equipment will temporarily detract from the aesthetics of the area.

The 1976 EIS states that the HMI project will be used for recreation. On the Back River side of the facility, a 3,000-foot beach connecting the previously separate Hart and Miller Islands to each other is maintained as a public park by the Maryland State Forest and Park Service. The Hart-Miller Island State Park is a well recognized and appreciated State recreational facility, as evidenced by the presence of approximately 1,000 boats from which visitors enjoy the beach on any given summer weekend. Fishing is permitted around the bayside perimeter of the dike, with the exception of dredged material unloading areas. Recreational projects completed include segmented breakwaters, a floating pier, beach nourishment, first-aid and comfort stations, an observation tower, and a boardwalk on Hart Island. MDNR and Baltimore District initiated a feasibility study for long-term environmental restoration and recreational development of the approximately 300-acre South Cell and developed a conceptual plan for the development of the South Cell. Restoration of the South Cell is scheduled to start in the fall of 2001.

Prior to and during construction, citizens were concerned that the project would create offensive odors that would be noticeable at their residences. This has not been the case, and MPA has indicated that it receives no complaints related to odors generated at the site.

Poplar Island

The Poplar Island restoration project is in the process of start-up operations. Dredging and construction equipment is currently on site constructing Phase II. A hydraulic unloader, tugs, and scows will also be on site during dredged material placement operations. The placement and dewatering of dredged material will take place during the life of the project. The current view of the project from the shoreline residences of Talbot County is one of a 20-foot high dike that does not interrupt the view of Coaches or Jefferson's Island. The restoration of Poplar Island is intended to provide wildlife habitat after completion of the project. Aesthetic resources are expected to include upland and wetland vegetation and associated wildlife. Both wetland and upland habitat would be present at the site.

4.14.6 Recreation Resources

Tolchester Channel S-Turn

The recreational setting in the Tolchester Channel is generally limited to boating-related activities. Recreational fishing activity occurs primarily in the outer regions of the Harbor and in the Chesapeake Bay. Sport fish frequently sought include white perch, channel catfish, striped bass, bluefish, and weakfish. Blue crabs are also recreationally harvested in the area. Conflicts with commercial navigation are rare.

There is a small marina, at the southern end of Tolchester Beach, which lies within 1/4 mile of the northern end of the existing S-Turn. The docking facilities are within a basin that is protected from the prevailing northwest winds and waves/fetch by a breakwater. The marina owners report wave heights that have flooded over the beach and parking lot during extreme weather conditions and as a result of ship wakes. Tolchester Beach lies just north of the project area, within 1/2 mile of the entrance to the S-Turn. Fishing and swimming are popular recreational activities at Tolchester Beach. Waves and currents at the Beach can be dangerous. On June 21, 1986, a 7-year-old child drowned reportedly due to being drawn off the shore by ship-induced Bay waves. The beach remains a popular recreation area.

HMI and Poplar

While the placement sites are operating, access to the islands is limited and, therefore, recreational activities are limited to the HMI State Park and water-based recreation. A variety of water-based recreational activities occur throughout the Bay depending on the season and on weather conditions. The most popular recreational activities in the area are fishing and boating. Marina and boat launching facilities are available along the eastern and western shores of the upper Bay. Recreational boating is very popular in the vicinity of both placement sites. Fishing for several species, including striped bass and white perch, is especially popular in the shallows near both islands. There is a "trophy" striped bass season in the spring (late April through May) with a minimum size of 28 inches, and a subsequent summer/fall season with a smaller size limit, which extends from June 14 to November 30 (MDNR 1999). The white perch fishing season is typically open year round with no minimum size restrictions.

4.15 ENVIRONMENTAL JUSTICE

Executive Order 12898 was established to protect low income and minority populations, because it was recognized that some actions might disproportionately favor higher income populations or put lower income populations at higher health and safety risks. No low income or minority populations are located in the immediate vicinity of the proposed project or either of the placement sites. Further, no low-income group is disproportionately reliant upon the sites or their resources.

4.16 SAFETY FOR CHILDREN

On April 21, 1997, President Clinton issued Executive Order 13045, Protection of Children From Environmental Health Risks and Safety Risks, which recognizes that a growing body of scientific knowledge demonstrates that children may suffer disproportionately from environmental health and safety risks. This Executive Order requires Federal agencies, to the extent permitted by law and mission, to identify and assess such environmental health and safety risks.

4.17 NAVIGATION

The Tolchester Channel provides a vital link between the Port of Baltimore and the Chesapeake and Delaware Canal. In 1999, 9,117 vessel trips were made on the waterway, carrying approximately 14.6 million tons of commerce. Commercial vessels using the waterway include tugs and barges, general cargo ships, car carriers, tankers, bulk carriers, and containerships up to 965 feet long.

The existing channel, which is authorized and constructed to 35 feet deep and 600 feet wide with necessary widening of the turns, follows the naturally deep water on the eastern side of the Chesapeake Bay. The channel turns have been widened over time and the last widening in 1992 ranged from 1,020 to 1,250 feet wide. The dredged portion of the channel extends a distance of approximately 7.2 miles, from approximately one mile south of the intersection with the Brewerton Channel Eastern Extension (approximately two miles southwest of Swan Point) to naturally deep water off Tolchester Beach. The channel comes within 1,000 feet of shore and changes direction four times, creating what is referred to as the "S-Turn" just south of Tolchester Beach. This requires pilots to make three to five course changes over a distance of three miles.

The channel is well marked with floating aids to navigation, with gated buoys (one buoy on each side of the channel) spaced approximately one mile apart on the straight portion of the channel, and buoys marking the entrances and apexes of the turns. The U.S. Coast Guard completed constructing the range lights south of the Tolchester Channel in January 2001, which mark the centerline of the straight portion of the existing Tolchester Channel between the Brewerton Channel Eastern Extension and the Tolchester Channel S-Turn. These ranges cannot be used for the existing S-Turn portion of the Tolchester Channel. Straightening the S-Turn will allow pilots to take advantage of the range lights in the new channel alignment.

The channel is generally aligned with the direction of the prevailing tidal currents, although the currents are more oblique to the channel through parts of the S-Turn. The channel is subject to adverse weather conditions such as fog and thunderstorms which reduce visibility; ice conditions which reduce the maneuverability of vessels and can obscure and move floating aids to navigation; and high winds which can reduce maneuverability. The combination of three to five course changes within a three-mile section of channel, the channel coming within 1,000 feet of the shoreline, and the periodic adverse weather conditions make navigation of the S-Turn difficult. The U.S. Coast Guard states that the S-Turn is one of the most difficult challenges in the Fifth Coast Guard District. Three vessel groundings occurred in the S-Turn between 1983 and 1991, and three vessel groundings occurred in the immediate vicinity of the S-Turn between 1981 and 1986. The Association of Maryland Pilots states that near misses continue to occur. The Pilots request that the S-Turn be straightened to improve navigation safety. The new channel will be cut west of the existing S-Turn, resulting in some parts of the channel being nearly 1/2 mile further from shore than the existing channel.

4.18 MOST PROBABLE FUTURE WITHOUT-PROJECT CONDITIONS

The without-project condition is defined as the most likely condition expected to prevail over the length of the planning period (in this case, 50 years) in the absence of the Federal government implementing a plan of improvement. The without-project condition provides the baseline condition for estimating the benefits of improvements, the dollar costs of implementing improvements, and other impacts associated with any improvements.

The Port of Baltimore will continue to function as one of America's busiest deep-water ports. Its waterside and landside infrastructure will continue to accommodate a diverse mix of commodities and vessel types throughout the study planning period. Continued use of the Tolchester Channel S-Turn rather than a straight channel continues the risk of groundings and collisions with possible environmental damage, oil and other cargo spills, injury, loss of life, and economic loss. The efficiencies of reduced shipping transit time due to the slightly shorter channel, would also not be realized.

Few impacts are associated with the project (Section 5). The resources that are most likely to be impacted are water quality, sediment quality, and fisheries and are described in the following sections.

4.18.1 Water Quality

Water quality in the Chesapeake Bay has shown trends of some improvement in recent years due to increased treatment and control of industrial and domestic pollutant sources. State and Federal policy-makers have been steadily raising the standards and restrictions on surface water inputs since the late 1970s. Additionally, stakeholders within the Chesapeake Bay watershed have become increasingly aware of the role of water quality to the health of the Bay, which has facilitated improvements in many land-use practices. For example, vegetated buffers and other Best Management Practices are being employed throughout the watershed to improve the clarity and quality of surface water runoff. Although some areas of the Bay still exhibit seasonal oxygen depletion (which is exacerbated by nutrient inputs to the Bay), these conditions are improving in some areas. However, population growth and the continual point source contaminant inputs, non-point source inputs, and atmospheric deposition will continue to stress the Chesapeake Bay potentially negating the incremental improvements in the watershed.

4.18.2 Sediment Quality

All sediments in the proposed realignment area of the Tolchester Channel S-Turn can be assumed to be very soft, highly plastic, silty clay with occasional fractions of shell or shell fragments, sand, gravel and cobbles, and some wood. No significant change in sediment quality is expected with or without the proposed project.

4.18.3 Fisheries

Fisheries populations within the Bay are currently in a state of flux. Abundances of some species (e.g., striped bass) are stable and supportive of current harvest levels largely due to conservation and restocking efforts. Other finfish species (e.g., herring species, eels) are still suffering the effects of overfishing and blocked passages on freshwater rivers/streams. Shellfish that historically have constituted a significant proportion of the total Bay harvest (oysters, crabs, and soft clams) are currently at low levels. The Oyster

Recovery Program is trying to replenish the oyster population with reseeding and transplanting efforts. More stringent restrictions on crabbing are being implemented in Maryland waters. Regardless of the proposed project, Maryland fisheries resources will need to be closely monitored and managed to ensure the future health of commercial fisheries populations.

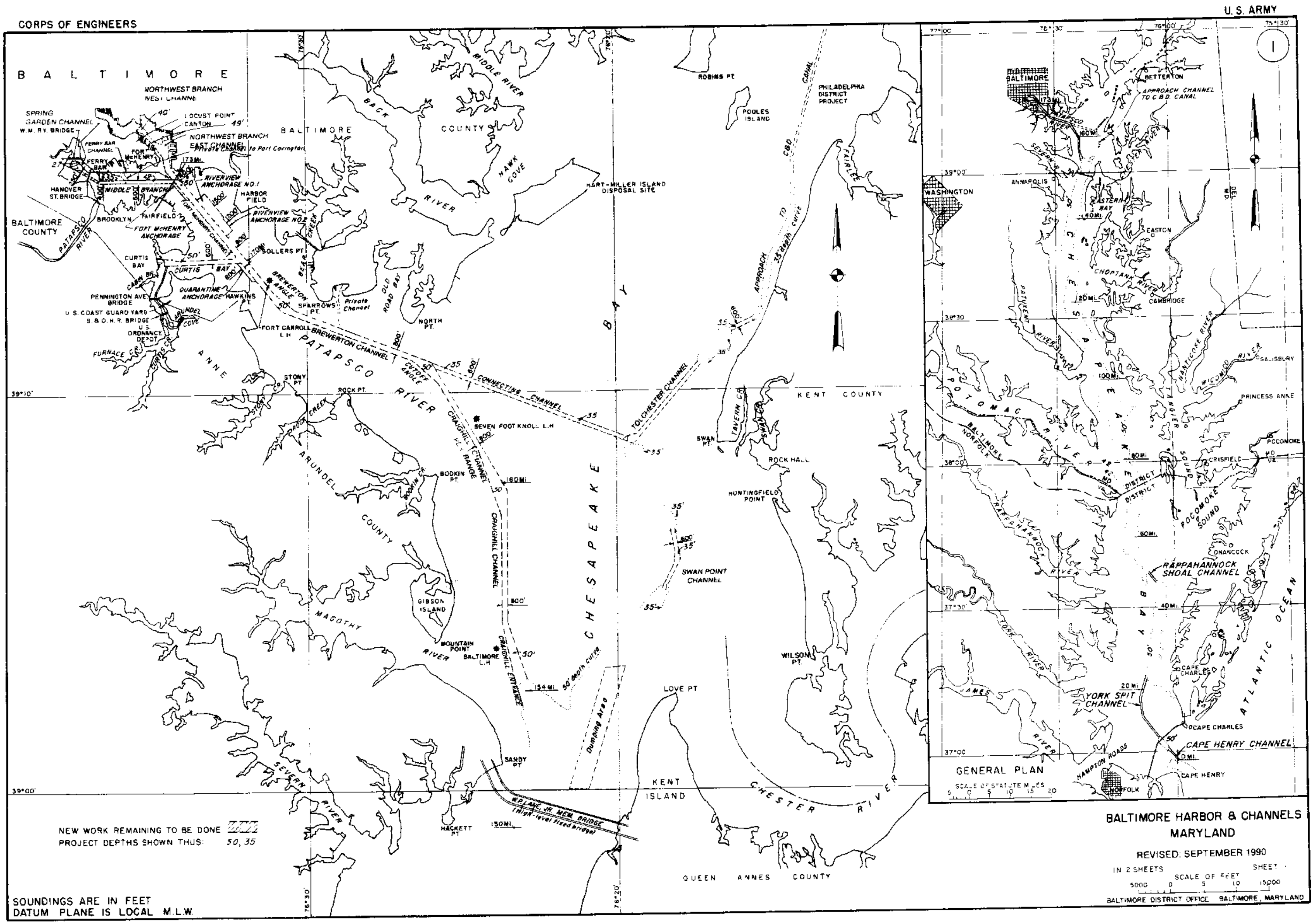

Figure 4-1. Baltimore Harbor & Channels Forty Two and Fifty-Foot Projects—Maryland Channels

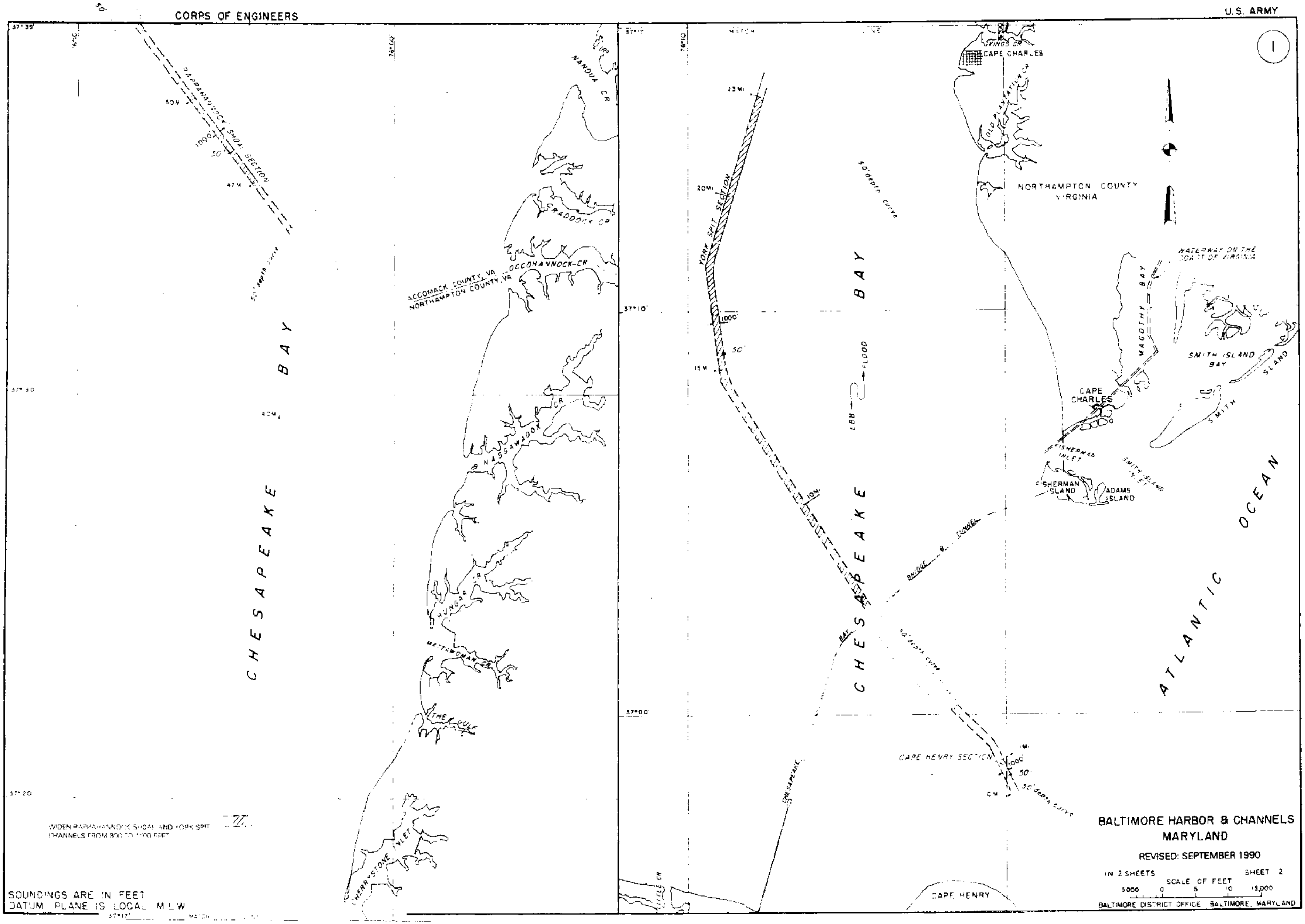

Figure 4-2. Baltimore Harbor & Channels Fifty-Foot Project—Virginia Channels

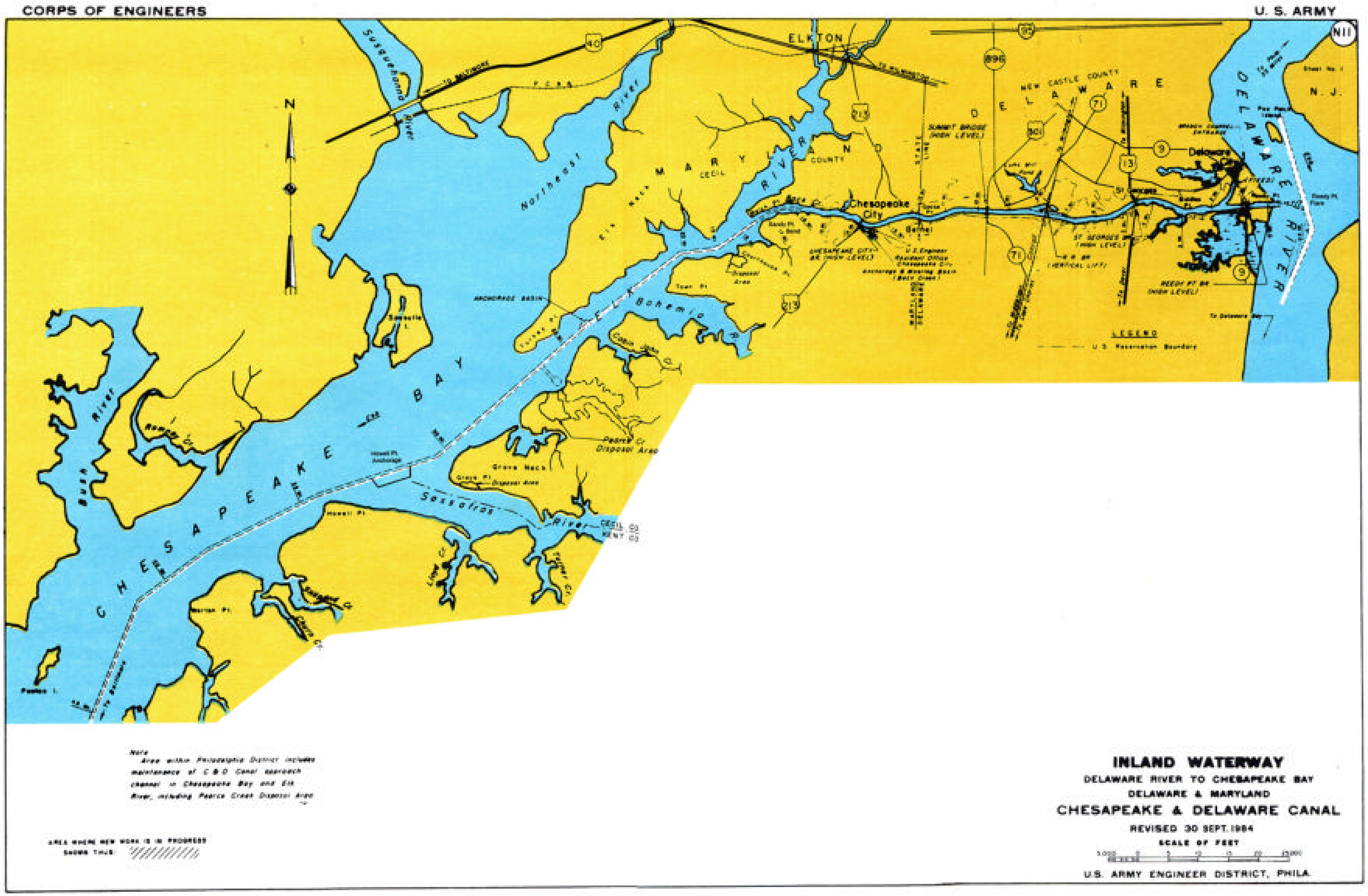

Figure 4-3. Inland Waterway and C&D Canal, Delaware and Maryland

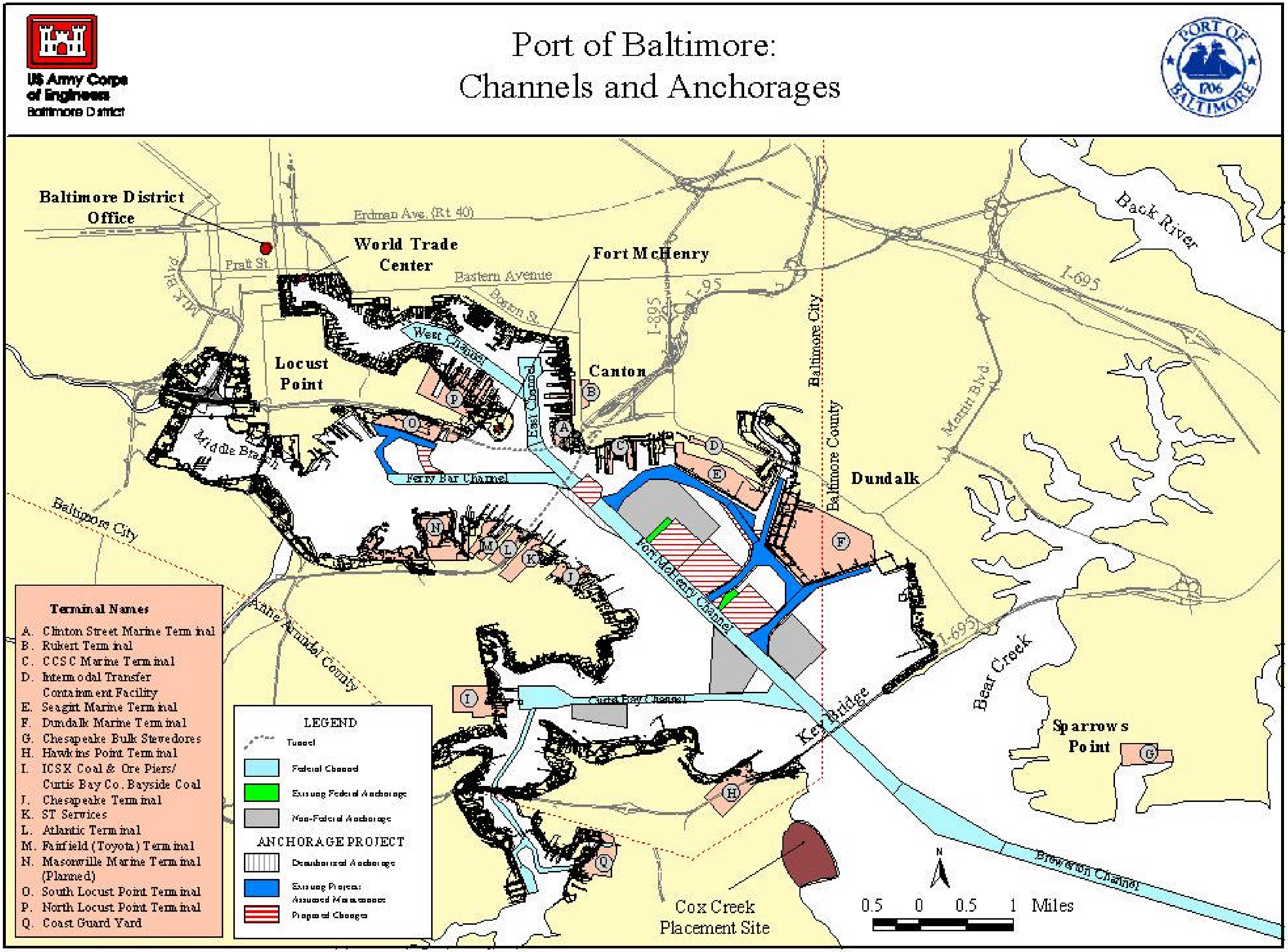

Figure 4-4. Port of Baltimore Channels and Anchorages

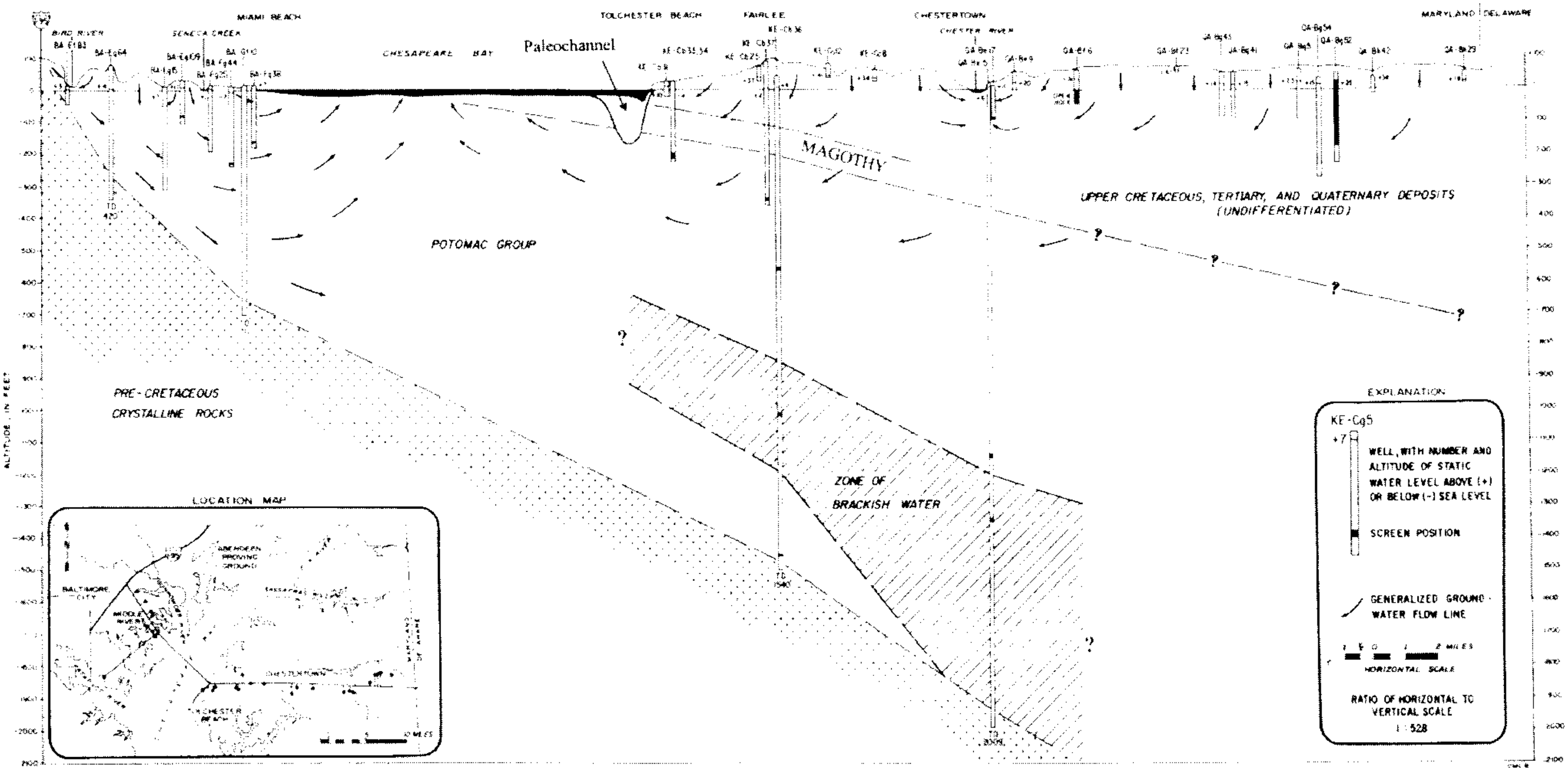

Figure 4-5 —Geohydrologic section from I-95 in Baltimore County across the Chesapeake Bay to the Delaware line showing regional geology, generalized ground-water flow lines, and occurrence of salty water.

(Based on Fig. 12, Otton and Mandle, 1984)

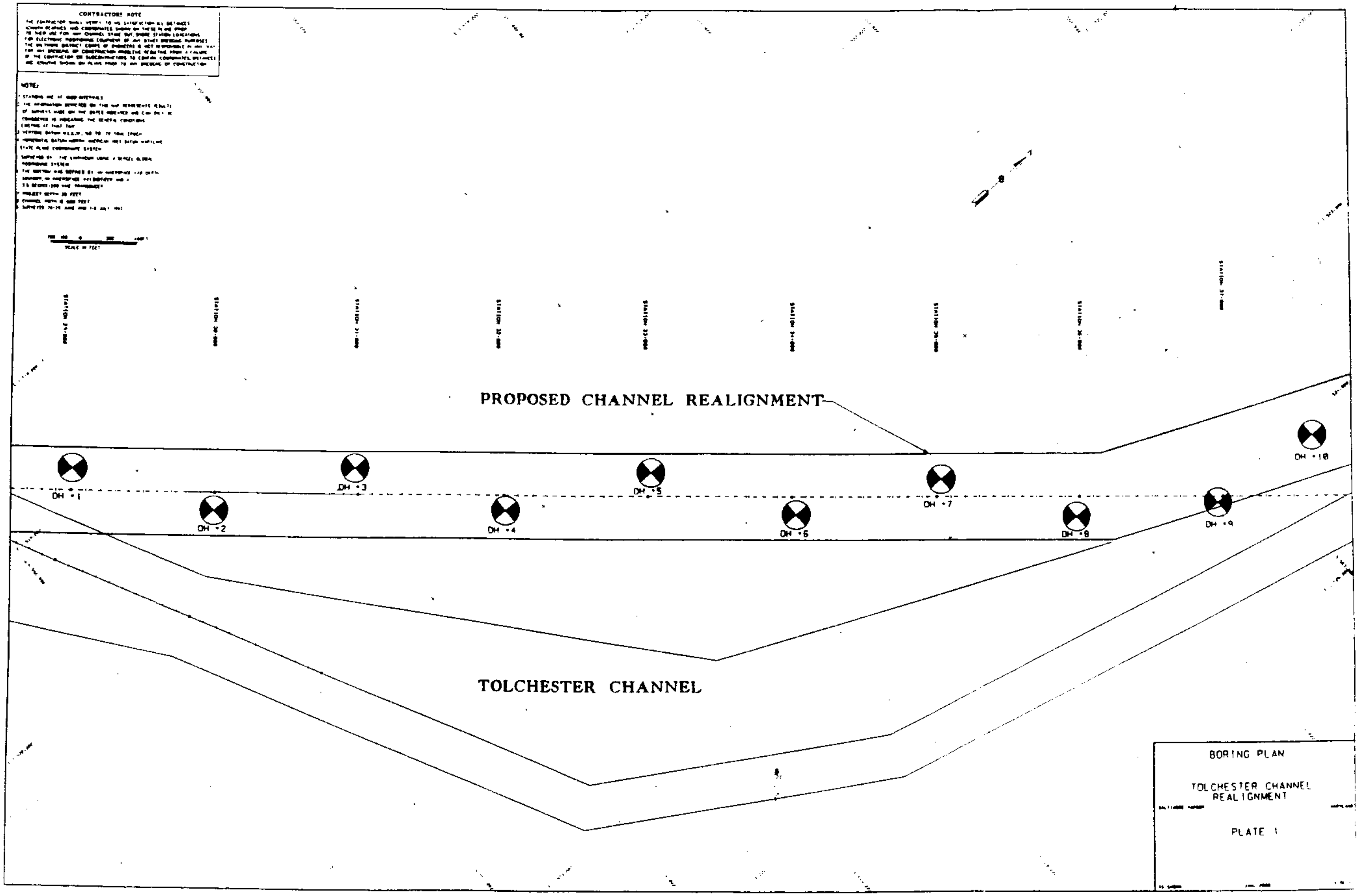

Figure 4-6. Geotechnical Boring Locations in the Proposed Tolchester Channel S-Turn Straightening Area

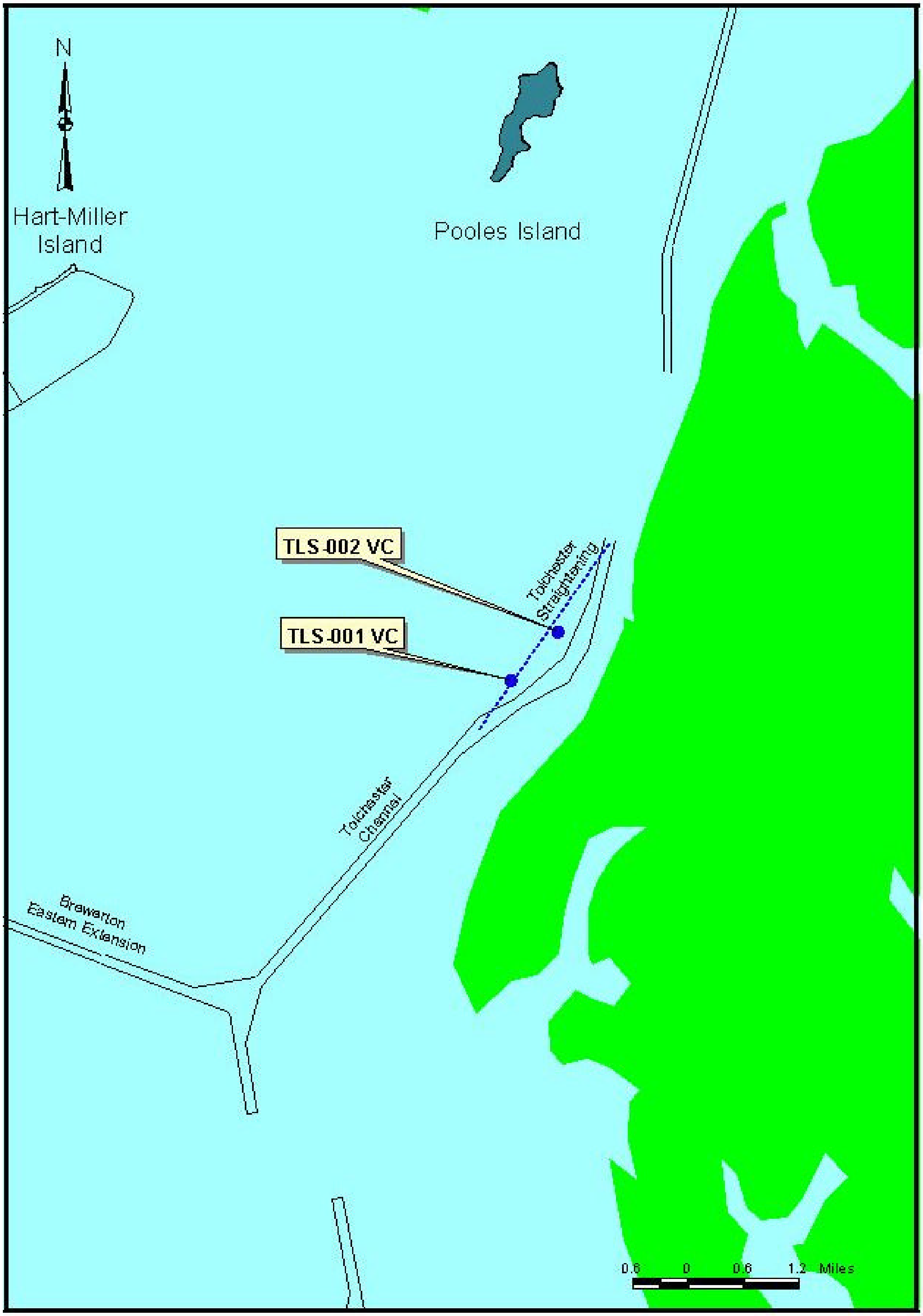

Figure 4-7. Vibracoring Locations in the Tolchester Straightening.

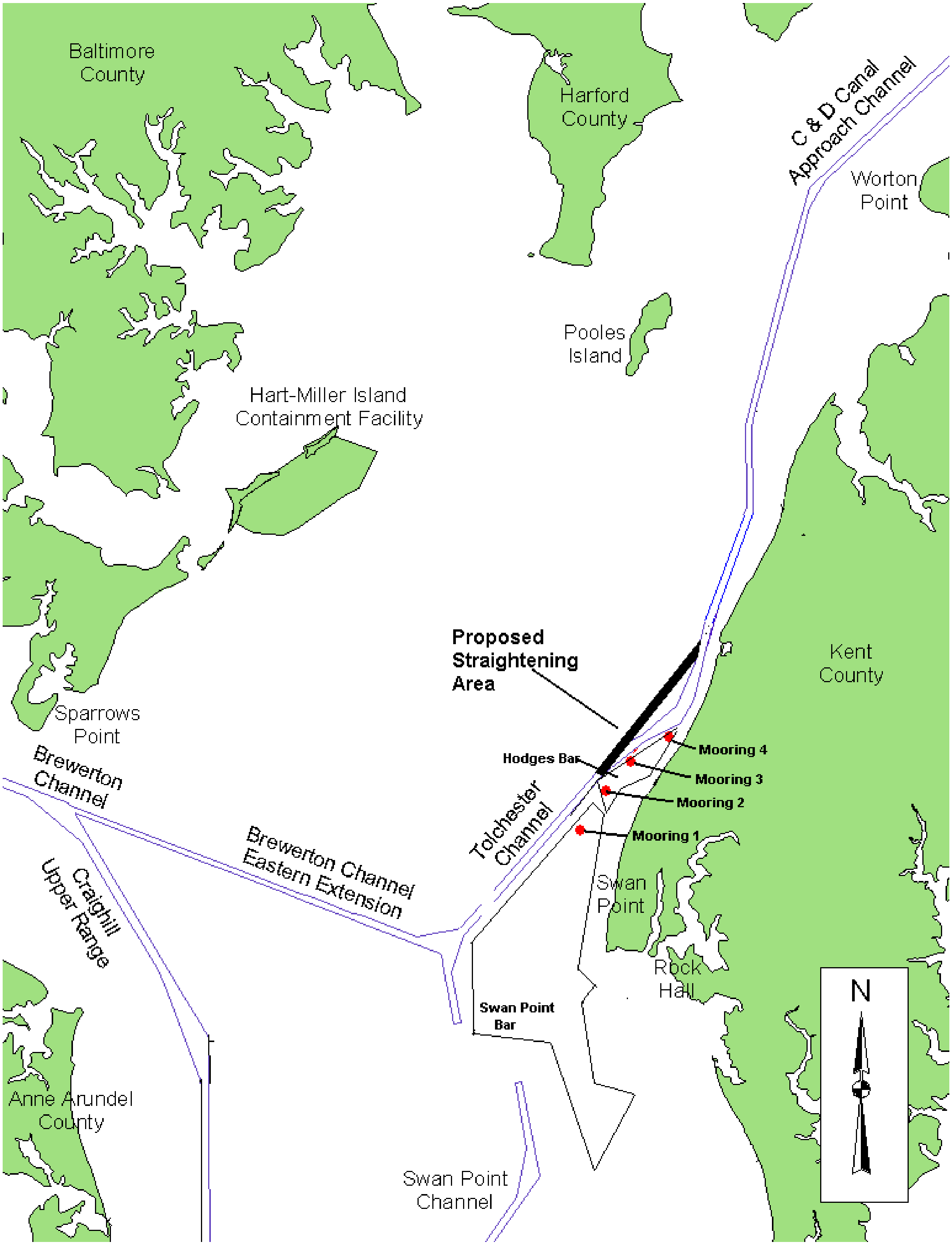

Figure 4-8. Current Meter Mooring Locations

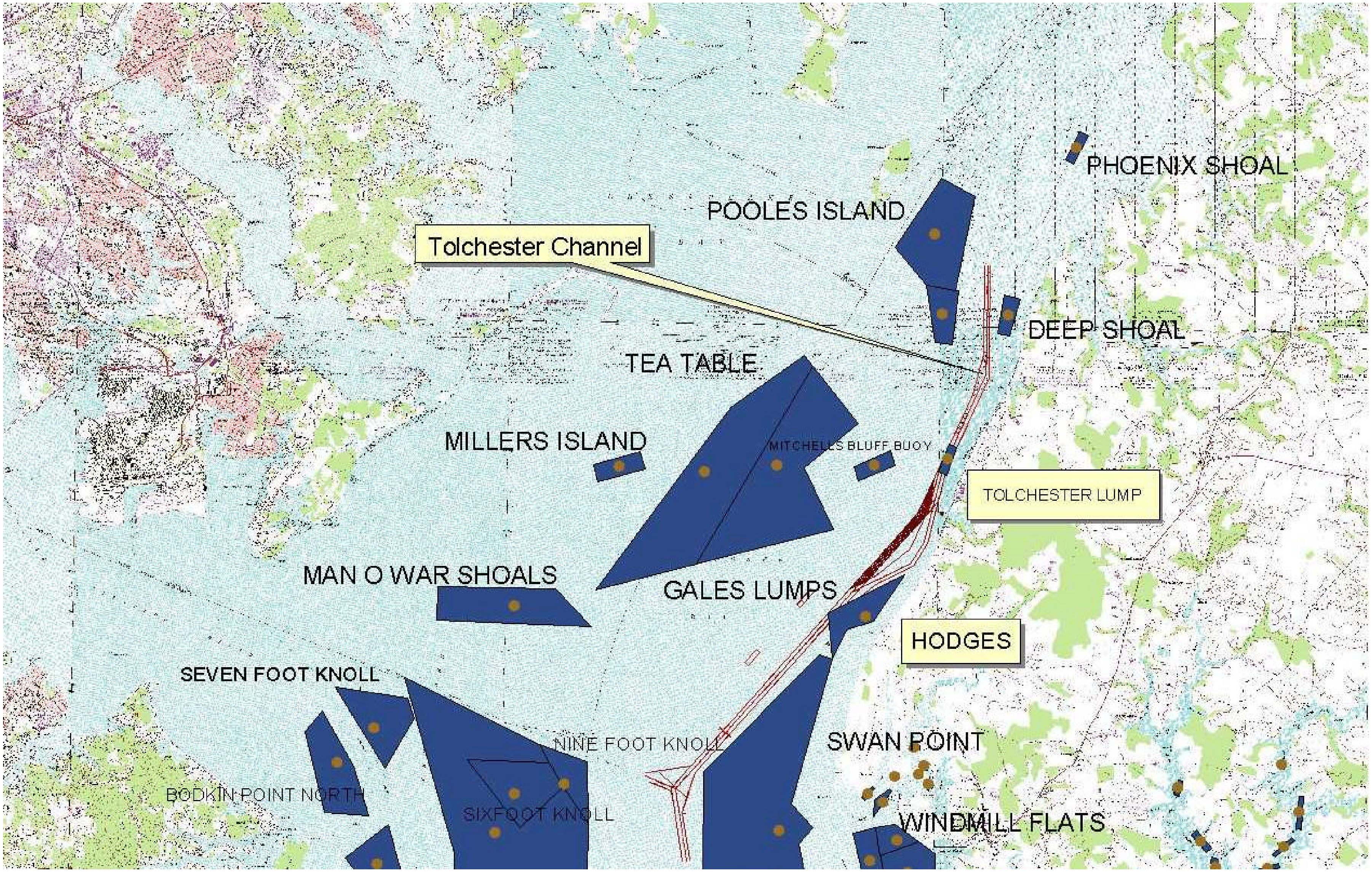

Figure 4-9. Oyster Bars in the Vicinity of the Proposed Tolchester Channel S-Turn Straightening

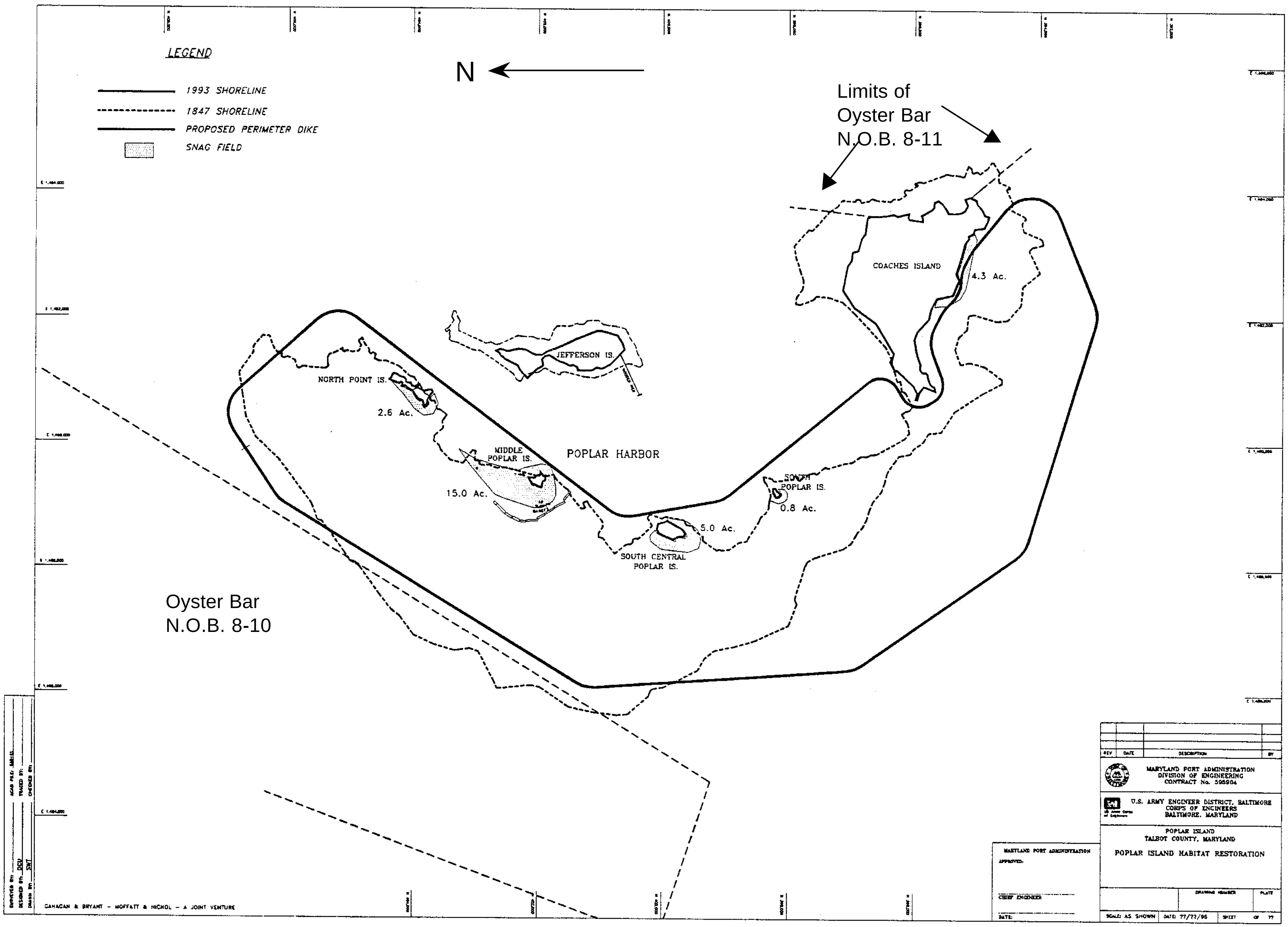

Figure 4-10. Oyster Bars in the Vicinity of Poplar Island

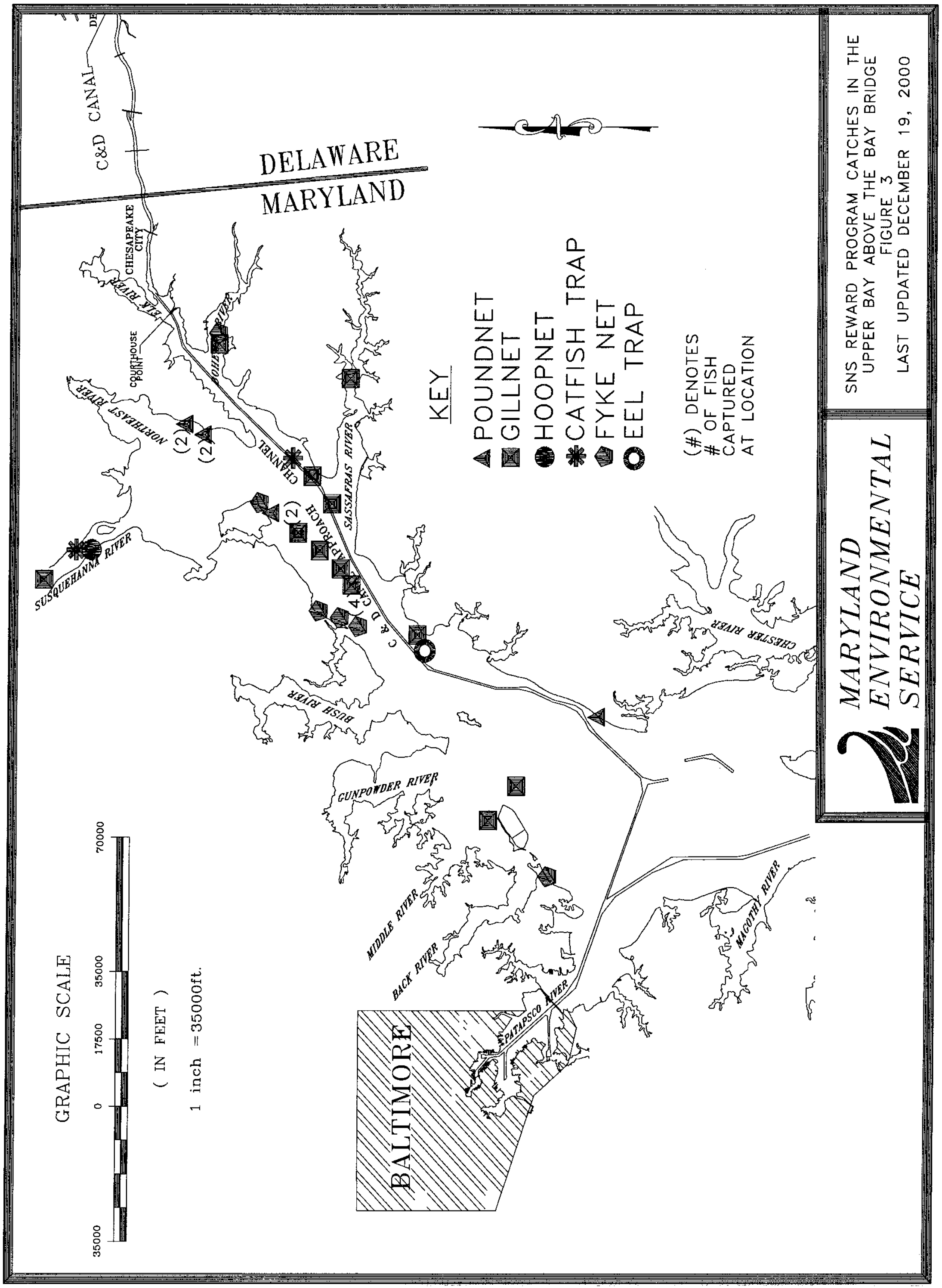

Figure 4-11. Shortnose Sturgeon Reward Program Catches in the Upper Bay (above the Bay Bridge)

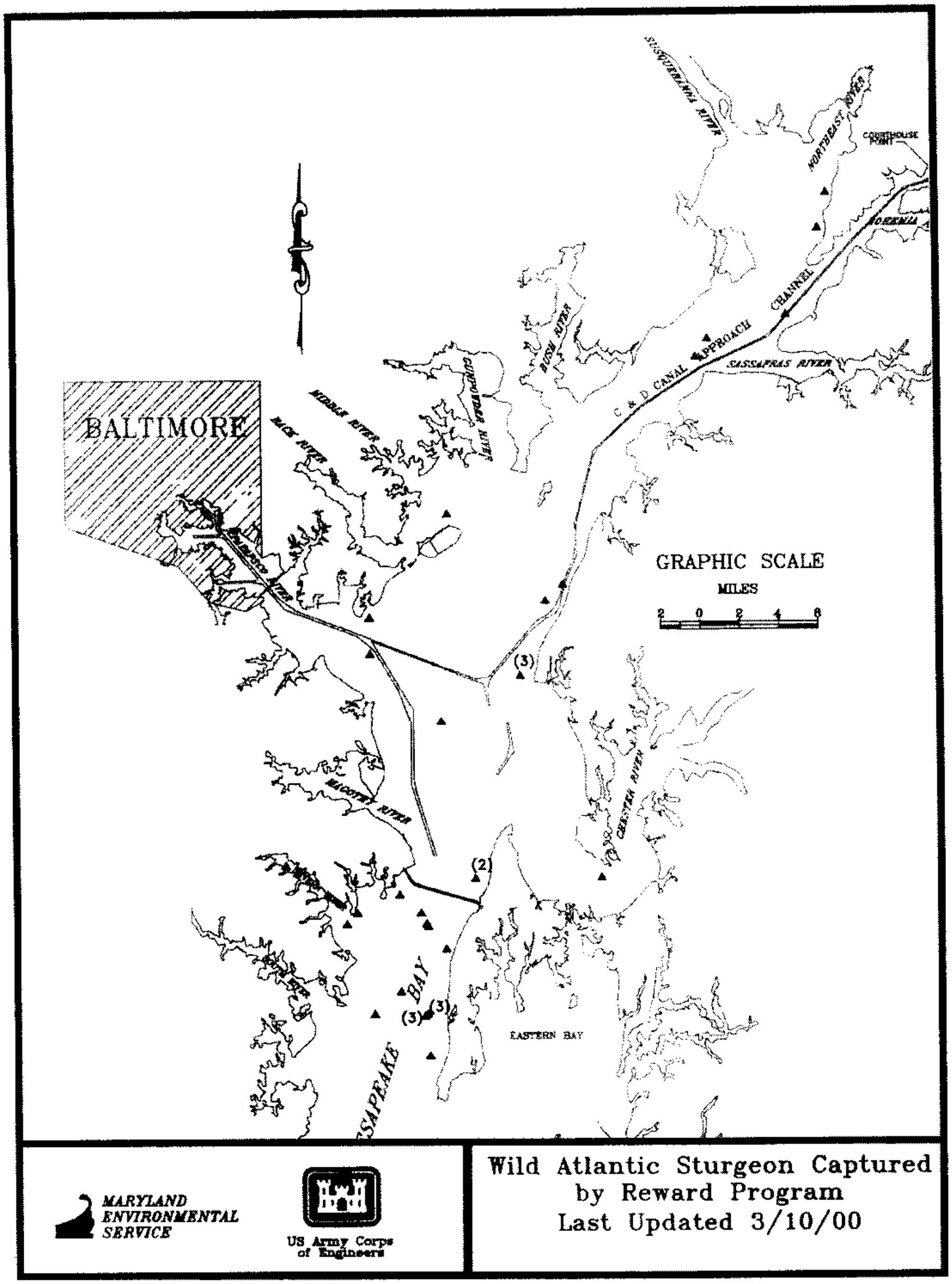

Figure 4-12. Wild Atlantic Sturgeon Captured by the Reward Program

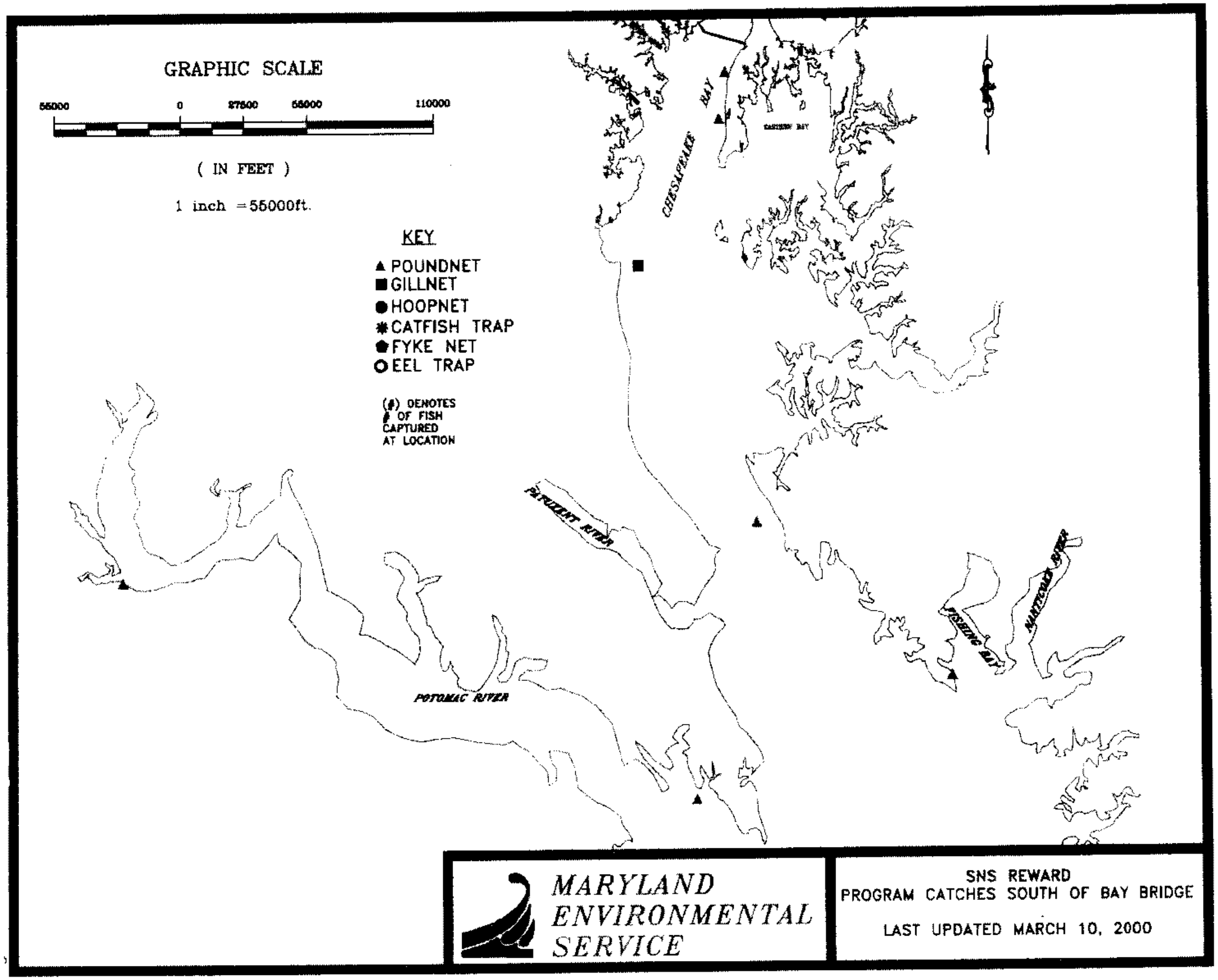

Figure 4-13. Shortnose Sturgeon Reward Program Catches South of the Bay Bridge